ELECTRICAL REVIEW

Vol. CLI 15th AUGUST, 1952 No. 3899

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EDITORIAL, ADVERTISING & PUBLISHING OFFICES: Dorset House, Stamford Street, London, S.E.1. Telegraphic Address: " Elecrev, Sedist, London." Code: ABC. Telephone No. Waterloo 3333 (60 lines). Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription: Home and Overseas £3 6s 0d: U.S.A. and Canada $11.00. Cheques & P.Os. (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD. and crossed " Lloyds Bank."

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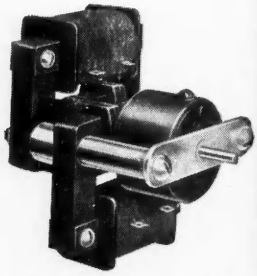

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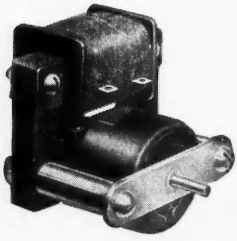
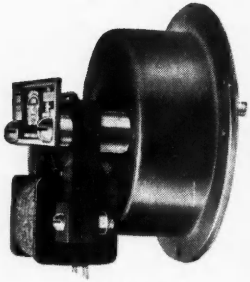


Type MB Motor



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ELECTRICAL REVIEW 15th AUGUST, 1952

THE OLDEST ELECTRICAL PAPER • ESTABLISHED 1872 • VOL. CLI • NO. 3899

Coal Price Adjustments

UNRESTRICTED freedom in the purchase of coal before 1935 provided a conveniently flexible means of meeting combustion requirements at individual power stations. Little was therefore done to put prices on the scientific basis of heat content. With the final wiping out of normal commercial arrangements through the imposition from 1940 onwards of identical increases in the price per ton of coals, whatever their value, the need for such a basis became imperative. Indeed the anomalous position was reached in which the cost per therm of ash-laden untreated smalls was actually higher than that of better qualities. In the new price structure introduced last December, particulars of which have been given in our columns, the National Coal Board, recognizing that gross calorific value as received did not furnish the full measure of the value of fuel, introduced an " ash penalty " and allowed for other factors that affect combustion. The steep rise in the penalty with the proportion of ash is justified by the greater difficulties of dealing with excessive amounts, since it is appreciated that ash is not only a diluent of coal. It also affects the capital expenditure requisite to secure constant steam output, boiler availability and efficiency and maintenance. In addition it adds to charges for transport, handling and disposal of the residue. A further allowance is made for saving of expense at the collieries when coal is not washed or cleaned. There are a number of other possibly detrimental characteristics of coal which are not so readily measured, such as inconsistency of quality, friability, and the presence (even as fractional percentages) of sulphur, phosphorus, chlorine or other chemicals.

The adjustment required for these is said to be probably a shilling or less for bituminous coal, but it is likely that extended experience under working conditions will rate their influence much more highly. More precise evaluation, it seems, must await the solution of the several research problems discussed by

Mr. W. F. Simonson at the British Electrical Power Convention in June. In substituting a scientific price structure for the former rough and ready but not unsuccessful willing buyer-seller method, the National Coal Board would do well to retain as much as possible of the flexibility of the latter and to regard as one of the chief objects of a national fuel policy the encouragement of the burning in electric power stations of coals that are not suitable for general industrial, carbonizing or export purposes.

EXPORT VOLUMES

Statistics published in the *Board of Trade Journal* underline the trend to which we referred last week—the downward movement of exports of electrical goods and apparatus. In the second quarter of this year the volume index figure (1947=100) was only 147 as compared with 168 in the first quarter. The latter, however, was abnormally high but the June quarter exports were still below those of the corresponding period of last year. The figure of 167 for "machinery and parts thereof," in which electrical machinery and heavy plant is included, although lower than in the first quarter was still above the index for the second quarter of 1951 (150). The average value index for electrical goods and apparatus, at 150, was slightly above the figure for all products (146). It is of interest to see that, whereas the average value index for exported machinery and parts was 145, the figure for imported machinery was 162.

TRAFFORD GAS TURBINE

The 15,000 kW gas turbine (described on another page) which has been commissioned at Trafford (Lancs.) power station, is the first to be put on commercial load in the public electricity supply service. Its quick starting characteristics make it especially suitable for peak and emergency duties, to which the use of gas oil fuel (even if later modifications enable it to run on heavier oils) might appear to restrict it economically. On the other hand, components and auxiliaries seem elaborate for intermittent work. An important consideration, however, is that manufacturing and operation experience of a new type of plant that is capable of running with good efficiency at high load factors is most desirable.

PER UNIT SYSTEMS

The advantages of "per unit" over percentage systems are stated by Mr. N. N. Hancock in the "Bulletin of Electrical Engineering Education" (Manchester College of Technology). Power factor, for instance, is expressed as, say, 0·8 instead of 80 per cent. which obviates the need for first multiplying by 100 and then, before making calculations, dividing by the same 100. The per unit system also avoids risk of error in hasty multiplications of percentages; e.g., 50 per cent by 50 per cent, which is, of course, not 2,500 but 25 per cent, whereas $0{\cdot}5 \times 0{\cdot}5$ automatically gives the correct figure at once. As the author pertinently asks: "Why multiply by 100 in the first place?"

WORKERS' KNOWLEDGE

The eleventh of the series of studies of nationalized industry by the Acton Society Trust, 39, Welbeck Street, London, W.1, is entitled "The Worker's Point of View" (2s). It opens by stressing the importance of acquainting employees of the "purpose, policies and progress" of the industry with which they are connected. This study is based entirely upon a survey by one research worker in a single coalfield. Thus while the conclusions may have some general application this is by no means certain. The answers by 204 men to a questionnaire are tabulated. We are inclined to think that better results would be obtained from a similar set of questions put to men engaged in the electricity supply industry.

Pakistan Power Supply

Development Schemes in Active Preparation

By F. H. SHARPE, B.Sc., M.I.C.E., M.I.E.E.*

WHEN Pakistan came into being in August, 1947, as the result of the political partition of the Indian sub-continent, the state of electricity supply, except in the few large cities, could be described as rudimentary. It was an agricultural country and enough food was grown for the needs of the population while jute, of which Pakistan produces some 75 per cent of the world's supply, raw cotton, hides and skins were exported for processing elsewhere.

Since partition much has been done to enable the maximum use to be made of existing plant but already the demand for power exceeds supply and the time has been too short for the planning and construction of the power stations which will be necessary to meet the new conditions. Hence the main interest in electricity supply for Pakistan lies in the plans for future development rather than in the present.

Divided Territory

The country is divided into two parts, separated by over 1,000 miles of Indian territory, which differ widely in climatic conditions. West Pakistan includes the North West Frontier Province, about half of the former province of Punjab,† Sind, Bahawalpur State and Baluchistan. Karachi, the Federal Capital, was formerly in Sind but is now administratively separate. East Pakistan comprises the eastern portion of the province of Bengal‡ (see map).

The general standard of living throughout Pakistan is very low and, particularly in East Pakistan, borders on the primitive. Many communities of 10,000 or more people have no public services; in some cases there is no telegraph or telephone and at certain times of the year no road access because of floods. Owing to the very low average income the demand for electricity for domestic purposes is small, even where supply is available; the total annual consumption does not exceed 2·5 kWh per head of population.

Plant Capacity in 1947

At the time of partition the total generating capacity in Pakistan was rather more than 40 MW, supplemented by a bulk supply of about 14 MW from Mandi in India to the Punjab. The greater part of the power was produced by old and inefficient diesel and steam plant, much of which had been without proper maintenance during the war and for which spare parts were not obtainable. In the larger towns electricity was supplied by private companies, except in the North West Frontier Province where the operation of the Malakand hydro-electric station, transmission and distribution were the responsibility of the Electricity Department of the Provincial Government. In some smaller towns and villages limited supplies of electricity were available from generating plant installed to serve mills or the special needs of military or railway authorities.

Many of these supplies were discontinued at the time of partition owing to the operators of the generating plant leaving the country. In the larger power stations difficulties were experienced owing to loss of trained staff and lack of local facilities for repair work. As a consequence, many supply authorities had to limit the maximum demand and to refuse further applications for electricity.

Following partition the Government decided that development schemes with the object of raising the standard of living and achieving a greater measure of economic independence should be given a high place.

† Both countries now call their part simply "Punjab" but where confusion may arise the special designation is Punjab (P).

‡ This was already called East Bengal at an earlier administrative partition, hence the provincial government is officially the Government of East Bengal.

* Messrs. Merz Rendel Vatten (Pakistan), consulting engineers.

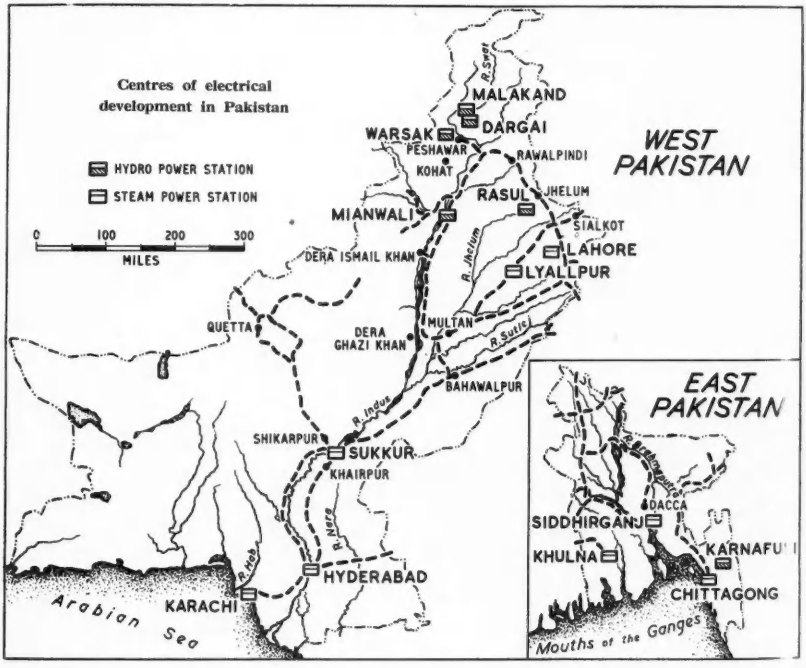
To ensure proper co-ordination of such schemes a Development Board was set up early in 1948 under the chairmanship of the Minister of Finance and Economic Affairs. A Planning and Advisory Board, consisting largely of industrialists and economic experts, was also formed to advise the Government on practical matters in connection with the schemes.

Survey of Requirements

It was apparent from the outset that the possible fulfilment of the development plans would largely depend on the extent to which electricity could be made available. At the request of the Government, Sir Henry Howard made a broad survey of the country's power requirements and estimated the demand by 1955 at 200 MW. This figure is substantiated by a very recent and detailed survey carried out by the consultants to the Government, who consider that the demand in 1955 will require 220 MW of generating plant. The larger figure includes provision for some 40 MW of pumping load in connection with de-watering schemes in Punjab. In many parts of West Pakistan, seepage from unlined irrigation canals has caused a rise in the water table of the adjacent land and an accumulation of salts, which is causing an annual loss of from 20 to 40 thousand acres of once fertile land. Experimental projects are in hand for reclaiming the land and water by pumping the water back into the canals; if these efforts are successful the procedure will no doubt be extended to other areas.

The estimated demand of some 200 MW in 1955 as compared with 50 MW in 1950 represents a phenomenal growth of load. It must, however, be borne in mind that the 1950 figure is artificially low due to limitation of generating plant and the fact that economic conditions have until recently been too uncertain to make the setting up of new industries attractive to private enterprise. Provided, however, that the proposed development plans materialize it is by no means impossible that the potential demand of 200 MW may exist in 1955.

To meet this initial rapid increase of



load and a subsequent steady growth, both an energetic short-term policy and a co-ordinated long-term policy will be necessary. With this in view Sir Henry Howard recommended the creation of a Central Engineering Authority to co-ordinate power development, and this body was set up in July, 1948, under the chairmanship of Mr. Mohsin Ali. The Authority is responsible for the initiation of schemes for the control and utilization of water and power resources and for the overall development and rationalization of electricity supply.

As regards increased generating capacity, the needs of the immediate future can obviously be met only by the provision of more thermal plant, either steam or diesel. A comprehensive survey of existing power stations has been made, covering rehabilitation and extension where possible, and a considerable number of new steam and diesel stations are planned. For the long-term policy an acute shortage of indigenous fuels in the form of coal and oil has naturally directed attention to the development of water power and the more so as such development would in most cases be combined with schemes for flood control and irrigation.

Potential Power Sources

Investigations already made indicate that the potential hydro resources in the North West Frontier Province amount to at least 5,000 MW, the major source of power being the River Indus and its tributaries. In view of the urgent need for power the greatest interest attaches to such projects as can be completed quickly: of these the most important is the proposed construction of a hydro station at Warsak, some 20 miles to the north-west of Peshawar on the Kabul river. This scheme would be capable of producing a maximum of 150 MW, the bulk of which would be transmitted to the Punjab. Reference to other hydro projects is made later.

As regards fuels, the coal resources of Pakistan have not been fully explored. At present some 300,000 tons is mined annually by crude methods; the price is high and the quality variable, the coal having generally a high sulphur content. Lignite is mined in Sind, but the extent of the deposit is not known. Oil occurs in the Attock district of the North West Frontier Province, but the amount obtained is small. Recently discovered sources in the Patheria Hills in East Bengal have not yet been fully investigated. It is not anticipated, however, that development of coal and oil resources will have any significant effect on the direction of policy concerning power generation. What therefore is the prospect of development of electricity supplies in the individual provinces?

PUNJAB

This province, which has a population of about 20 million and an area of 62,000 square miles, undoubtedly offers the best prospect for immediate industrial development. It contains the important towns of Lahore, Sialkot, Lyallpur and Multan, all of which have a considerable amount of light industry so that a pool of skilled labour of the artisan level is generally available.

The total maximum demand of the Punjab is at present a little over 20 MW. In the past a bulk supply up to about 14 MW has been taken from the Mandi hydro-electric station in the Indian Union, but this supply has now been considerably reduced and may be discontinued. Lahore has a steam power station at Shahdara in the north-west of the city containing three 3·15 MW and one 8 MW turbo-generators.

There are small steam generating stations at Rawalpindi, Sialkot and Multan, and a steam and diesel station is proposed for Lyallpur. About 20 towns have diesel generating stations. The only hydro generating station in the Punjab, except for some very small plant, is that now nearing completion at Rasul.* This station, which is initially to contain two 11 MW Kaplan water turbines, was planned as part of the de-watering project but will also cater for the needs of industry and domestic users. It will work under a head of 86ft, due to the difference between the levels of the upper and lower Jhelum canals. It will give full output at 70 per cent load factor for about five months in the year and a reduced output for the remainder. For some time Lyallpur has been supplied from Lahore by a 66 kV line, supplies being given to a number of towns en route. Very recently a 132 kV double circuit line 130 miles long has been constructed to interconnect Lahore and Rasul and 66 kV lines are being run from Rasul to Sargodha and from Gujranwala to Lyallpur. It may therefore be said that the nucleus of a grid scheme exists.

The immediate needs of the Punjab for

* *Electrical Review*, 16th May, 1952, p. 1051.

increased generating plant will thus be satisfied by the Rasul hydro station, extensions to the steam station at Shahdara, a new station at Lyallpur (probably to contain both steam and diesel plant) and thermal plant, mostly diesel, at smaller towns. In addition extensions to the 66 kV and 33 kV distribution systems will furnish supplies to many towns which have hitherto had unreliable supplies or none at all. It is proposed also to extend the 132 kV line northwards from Rasul into the North West Frontier Province where some surplus power will be available when a new hydro station at Darghai is in service.

It is anticipated that the Warsak hydrostation will be in operation by about 1960 and it is planned to transmit the bulk of the power to the Punjab at 220 kV. This, together with the thermal plant, should satisfy the needs of the Punjab up to about 1970.

Owing, however, to the time required for completion of Warsak a smaller hydro scheme at Mianwali has received consideration. This project is in the north-west corner of the Punjab and would deliver some 30 MW. The station would utilize a head of about 40ft between the main Thal Canal and the River Indus. The power would largely be used for the Thal irrigation project, the remainder being exported to the Lyallpur area. There is also the possibility of developing 200 MW of water power at a site on the River Indús 40 miles north of Mianwali.

NORTH WEST FRONTIER PROVINCE

This province has an area of about 14,000 square miles and a population of some 3·2 million of whom 30 per cent are urban dwellers. In addition the tribal tracts cover 24,000 square miles with a population of 2·5 million. Besides the agricultural crops normally grown in West Pakistan there is some cultivation of tobacco and extensive fruit growing in the Peshawar district. The total demand for electricity is rather more than 10 MW, of which 3 MW is taken by a cement factory at Wah. The province is in the happy position of having ample water power. The present needs are supplied from the Malakand hydro station which operates under a head of 250ft on the Upper Swat River. The station contains three 3·2 MW and two 5 MW turbines of the Francis type. A second station is under construction at Darghai, some few miles below Malakand, and will also work under a 250ft head. It will have four 5 MW sets so that the two stations will have a maximum output of about 40 MW. The hydro station to be constructed at Warsak will also be in the province and, although primarily intended to supply the Punjab, will also provide for future local load.

In addition to supplying the larger towns of Peshawar, Nowshera, Mardan and Charsadda an energetic development policy has resulted in supplies being taken to a large number of towns and villages by means of 66 kV and lower voltage lines. Although electricity has been available at cheap rates, the small demand for domestic purposes is evidence of the low standard of living.

On the western boundary of the province and on the west side of the River Indus there are a number of important towns of which Bannu and Dera Ismail Khan have small diesel generating stations. The possibility of supplying these towns from the hydro generating station has been considered, but the small loads make this idea an uneconomic proposition.

SIND

The greater part of the province is desert, but close to the River Indus there is a flourishing cotton growing belt in which the most important towns are Hyderabad and Sukkur. Since 1941 the population of Hyderabad has increased from 35,000 to 230,000. The bulk of the local industry is associated with agriculture, such as the husking and milling of wheat and the ginning of cotton, but a Trading Estate will cater for a wider industrial field: in addition to some heavy industry, cement, glass, footwear and textiles will be manufactured. New cotton mills with some 20,000 spindles are to be constructed on the Trading Estate and a separate project sponsored by the Government will involve the building of mills in the neighbourhood with some 50,000 spindles.

The low standard of industrial development and meagre demand for electricity for domestic purposes are shown by the fact that the total maximum demand for Hyderabad and satellite towns and villages, to which supply is taken by 11 kV lines, is less than 2 MW, but it is expected to grow to 11 MW by 1955. The Hyderabad

Electric Supply Co.'s station contains two steam turbines, one of which has a rating of 6 MW, and a new set is rated at 3·6 MW. There is also some 2 MW of diesel plant, most of which is over twenty years old. The Electricity Department has submitted to the Provincial Government plans for a new steam station which is to have two 7·5 MW generators.

The town of Sukkur, some 160 miles north of Hyderabad, owes some of its importance to the proximity of the Lloyd barrage on the River Indus which controls the irrigation of 10,000 square miles of country. Sukkur is scheduled for development by means of a Trading Estate and the development of satellite towns. It is proposed that the two small diesel stations which have an installed capacity of about 2·6 MW shall be ultimately superseded by a steam station and that electricity shall be taken to surrounding towns and villages within a radius of about 75 miles by 33 and 11 kV lines.

KARACHI

Karachi is the only port of West Pakistan and, since attaining its new status as Federal Capital, it has increased in population from 300,000 to over 1,000,000. In addition to the new Government buildings a Trading Estate has been established and large new residential colonies are being laid out. It is also an important military centre and the headquarters of the Royal Pakistan Navy and the Royal Pakistan Air Force.

Electricity is furnished by the Karachi Electricity Supply Corporation from a steam generating station at West Wharf in the harbour area and a diesel station some three miles to the east. The West Wharf station contains one 4 MW and one 5 MW turbines; it is anticipated that by the end of 1952 three further 5 MW sets will be installed. The diesel station has an effective capacity of 5 MW; a new 1·9 MW set will shortly replace some of the very old plant.

Until recently the load has been limited to about 12 MW by shortage of plant, particularly boilers, and the increased demands for power and anticipated further rapid growth of load in the next few years have necessitated immediate action with a view to providing additional generating plant. Plans are now in hand for the installation of two 15 MW turbines at West Wharf, and a new generating station to be situated some 10 miles to the east is also under consideration. Main distribution in the city area is by cable at 6·6 kV, but new extensions are being made at 11 kV and a 33 kV system is projected.

BALUCHISTAN

The greater part of this province is arid and mountainous. Prior to partition the north-western portion close to the Afghan border was of considerable military importance. Quetta still remains a military centre, but its importance has declined and there is little prospect of development. The load in Quetta is mainly domestic and amounts to about 1·5 MW, the supply being used by fans and refrigerators in the warm weather and for space heating in the cold seasons.

BAHAWALPUR

This state has an area of 15,900 sq miles and a population of nearly 2 million. It lies to the south of the River Sutlej, along which there is a belt of fertile land 350 miles long and 40 miles wide irrigated by an extensive canal system and in which cotton grows prolifically. A small part of the cotton is spun and woven locally but the greater part, after ginning and baling, is forwarded to Karachi for export. Most of the mills are operated by wood-fired steam engines. They work for only five months in the year and few have plant for providing alternative employment during the summer.

The capital, Bahawalpur, has a small diesel generating station which serves the Government offices and a few shops and houses. At Bahawalnagar a small station provides power for water supply and to the canal colony. In addition there are two very small diesel stations giving supplies to the railway and the private generating plant of H.H. The Nawab. All supplies are d.c. and the total load is less than 0·5 MW.

Such industrial development as is at present planned will be mainly in the neighbourhood of Rahim Yar Khan, which is in the western portion of the state and on the main Karachi–Lahore railway. There a new textile mill and a factory for the manufacture of soap and the extraction of vegetable oils are under construction and will create a load of about 4 MW.

Projects for extension of the irrigation

system and reclamation of waterlogged land by tubewell pumping are under consideration, but are too indefinite for any estimate to be made of the probable load. Although a number of municipalities are anxious to have electricity the small loads contemplated and the distances involved preclude any consideration of an interconnected distribution system, so that local generation is the only practical method of supplying both the domestic and industrial demands.

EAST PAKISTAN

This province has an area of 54,000 square miles and a population exceeding 42 million, of which only about 5 per cent are urban dwellers. It is a country of very high rainfall, the annual average being over 100 inches. Much of the land is low-lying and swampy and is thus particularly suitable for the cultivation of rice and jute, in which 80 per cent of the population is engaged. Living conditions and agricultural methods are primitive in the extreme, cultivation being carried out largely by means of wooden ploughs drawn by oxen. In view of the very low standard of education mechanization of agriculture must necessarily be a very slow and gradual process, and any rapid increase in the use of electricity for domestic purposes or rural development is unlikely. The main increase of load would come from extension of the port of Chittagong and the establishment of jute mills.

The development of Chittagong is obviously vital to the economy of East Pakistan, and it is to be expected that much of the new industry to be established will be situated in that neighbourhood in view of transport facilities and the availability of electricity. The immediate needs are to be catered for by additional diesel plant, to be followed by a steam station with two 10 MW turbines.

Although East Bengal grows 75 per cent of the world's jute there is as yet not a single mill in Pakistan for processing and it is even necessary to import jute products, such as hessian and gunny bags. It is hoped, however, to have 6,000 looms in operation by 1957 and 15,000 in ten years. Under a scheme sponsored by the Government three mills are being erected at Narayanganj, a few miles from Dacca, and another centre is to be established at Khulna, some 80 miles to the south-west. A steam station with four 10 MW turbines is to be constructed to supply the Narayanganj mills and also the future needs of Dacca, the provincial capital. A steam station with two 10 MW sets is planned for Khulna.

The only hydro scheme of any importance envisaged is the construction of a 40 MW station on the River Karnafuli 80 miles above Chittagong. It would be part of a multi-purpose project which would also provide for irrigation and navigation. The power would be transmitted to Chittagong and the Dacca area at 132 kV.

It has already been mentioned that the total demand for electricity in Pakistan is estimated to amount to 200 MW in 1955, which in view of the present load of about 50 MW implies a very rapid rate of increase. Such a demand can, however, only be created if the proposed development schemes are pursued in an energetic manner. Although a number of schemes are sponsored by the Government they will depend in the main on private investment, which until recently has been restricted by unstable conditions and uncertainty about the Government's future policy.

The Government has now indicated that it is not its intention to acquire or operate industrial concerns, but that it is prepared to assist in such matters as raising capital for schemes which would be beneficial to the country. This declaration of policy should go a long way towards allaying the fears of prospective investors.

It may be assumed therefore that in the next few years there will be a considerable market for electrical equipment of many kinds. On the generating and supply side the demand will be mainly for diesel and small steam sets with associated switchgear and cables. For industry electrically driven machinery for a wide range of manufactures will be required, in particular those associated with the processing of the agricultural products of Pakistan: cotton, wool, jute and skins. For domestic purposes the major demand will be for fans, refrigerators and air conditioning equipment. Lamps and ceiling fans are manufactured in Pakistan, but it is unlikely that they will be able to satisfy the country's needs.

The author wishes to acknowledge the assistance of his colleagues and the co-operation of the Central Engineering Authority of the Government of Pakistan through the chairman, Mr. Mohsin Ali, B.A.,M.Sc.,M.I.E., in preparing this article.

"Permitol" Capacitors

Correction of Fluorescent Lamp Circuit Power Factor

By **T. F. ROBINSON**, A.M.I.E.E., and **G. H. DYER**, Associate I.E.E.*

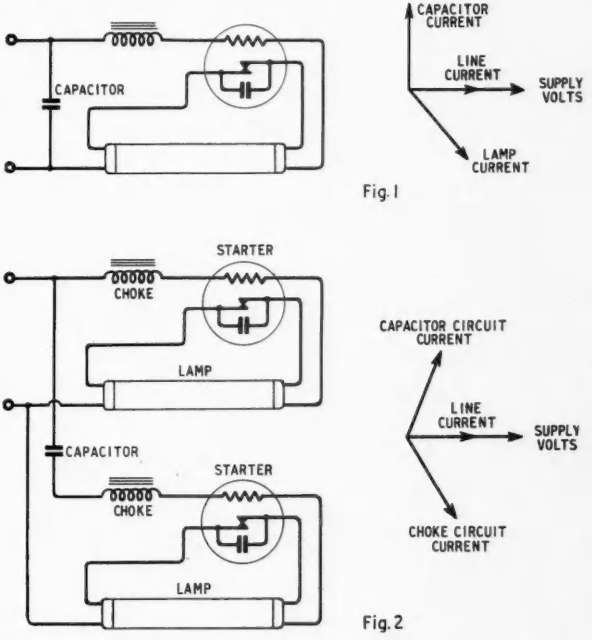
As the fluorescent lamp, like all discharge lamps, normally depends on a series choke for its operation, the overall power factor of such an arrangement is inherently poor, being of the order of 0·5. The large wattless current can be reduced by correcting the p.f. of such lamps so as to increase it to approximately 0·85. The correction is usually effected by associating a capacitor with each lamp fitting (Fig. 1) or with a two-lamp circuit (Fig. 2). In a single-lamp circuit it is connected across the input supply mains and is, therefore, rated at mains supply voltage, while in a two-lamp circuit, where the capacitor has to withstand a higher voltage, it is usually designed for working at up to 400 V.

Capacitors used for the normal range of fluorescent lamps, operating from 200/250 V 50 c/s mains, have capacities ranging from 3 to 15 μF, depending on the wattage of the lamps and the type of circuit in which the lamp is used. Such capacitors, so far as this country is concerned, are generally of the paper insulated petroleum jelly impregnated type, although some manufacturers use mineral oil or natural or synthetic waxes as the impregnant.

The British Thomson-Houston Co., Ltd., has recently introduced "Permitol"† impregnated paper capacitors into this country for use with its Mazda fluorescent fittings. They have the important advantage of being approximately 40 per cent smaller, and are also capable of operating at higher temperatures than the corresponding petroleum jelly impregnated type. Fig. 3 illustrates the reduction of size achieved by using "Permitol"

* The authors are both with the British Thomson-Houston Co., Ltd.

† Registered trade mark.



Figs. 1 and 2.—Single-lamp and two-lamp circuits with approximate vector diagrams

instead of petroleum jelly as the impregnant; the pairs illustrated are of equal rating.

" Permitol " is the company's trade name for a class of synthetic organic compounds which are used as dielectric media in electrical apparatus, such as capacitors and transformers. These compounds remain chemically stable at elevated temperatures, have excellent insulating properties and are non-inflammable. One of them is chlorinated diphenyl, which has the particular virtue, for use in capacitors, of a dielectric constant approximating to 4·5, which is practically double that of petroleum jelly or of mineral oil. This value fortunately happens to coincide approximately with the dielectric constant of the paper fibres, thus enabling a more equal distribution of electric stress in the capacitor winding to be obtained.

Chlorinated diphenyl has been used extensively in America for many years and to a lesser extent in other countries as an impregnating medium for capacitors, its use for this purpose having been first suggested by F. M. Clark of the General Electric Co., U.S.A.

Chlorinated diphenyls are produced as a series of compounds ranging from the monochlor up to as high as the decachlorodiphenyl. They range from thin viscous liquids up to hard transparent resins. Until recently they and similar materials have been imported from America, or from Europe, but Monsanto Chemicals, Ltd., have installed plant in this country for their production and have thereby made available an important range of electrical insulating compounds under the general title of " Aroclors."*

The fact that these compounds are synthetic, the basic materials being benzol and chlorine, is a further milestone in the efforts this country has made since the war to become more self-supporting.

Although the cost of chlorinated diphenyl is high compared to that of petroleum jelly, or other natural impregnants, the additional expense is offset by the considerable savings in paper, aluminium foil and container material in consequence of the high dielectric constant of " Permitol." The physically smaller capacitors which can be made in this way permit easier handling during factory production and increased output in terms of μF/sq ft of manufacturing floor area.

The second most important constituent in the composite dielectric of an impregnated paper capacitor is the paper insulation itself. However good the impregnant may be, consistency of the paper in thickness, density, insulating strength and dielectric loss is essential to reliability and long life.

Capacitor tissue falls generally into two grades: namely " rag," a wood-free tissue, and " kraft " which is produced from wood pulp. The former has hitherto been more extensively used in this country than the latter, one reason being that materials for making rag paper have been more readily obtainable from home production than wood pulp, which has to be imported, while for many applications the rag tissue has always been preferred. But kraft tissue has the very important merit of a smaller dielectric loss than that of rag tissue at elevated temperatures and, as one of the objects of the " Permitol " capacitor is operation at

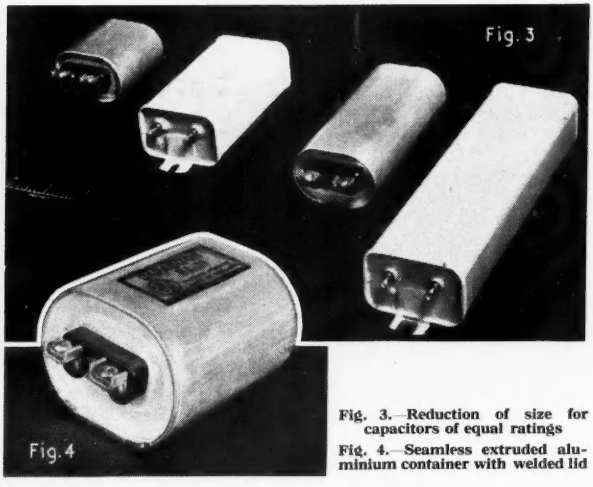


Fig. 3.—Reduction of size for capacitors of equal ratings

Fig. 4.—Seamless extruded aluminium container with welded lid

* Registered trade mark. See article by N. G. I. Thomas, *Electrical Review*, 17th August, 1951.

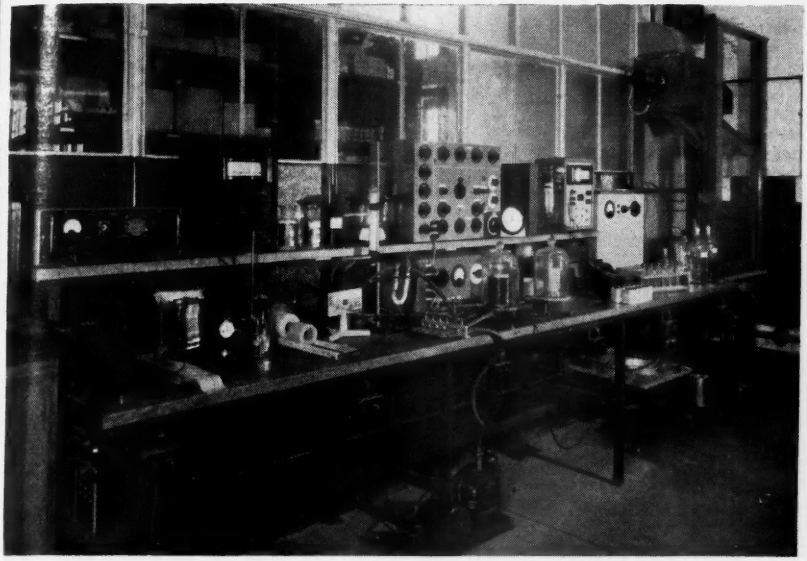


Fig. 5.—Material sampling equipment used for factory checking

higher temperatures, the use of kraft tissue in such capacitors is complementary for such applications.

Brittains, Ltd., in addition to producing the more conventional rag tissues, have also regularly been producing a range of kraft tissues which compare favourably with those of American and European origin.

Case design for capacitors using the new synthetic liquid impregnant has been studied. The difficulties of soldering can-seams and end-caps to avoid risk of impregnant leakage, especially at high temperatures, is well known. Consequently a seamless container was decided upon by the B.T.H. Co. and the form finally adopted after considerable experiment (Fig. 4) is impact extruded from high purity aluminium with a pressed aluminium lid welded to the case by an automatic argon arc process. The capacitor case is therefore seamless, gasketless (except for the terminals) and leakproof.

A special seal used in conjunction with a moulded terminal block prevents impregnant leakage at the terminals. The block is recessed to take the discharge resistor, which will ensure that the capacitor is in a discharged condition should it be necessary for work to be done on the lamp fitting when it is installed.

All materials used in the capacitor construction have to be carefully selected for use with "Permitol" to obtain the full and permanent benefit from its use. Similar precautions are necessary in the

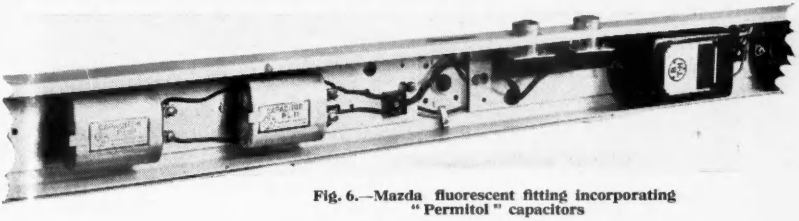


Fig. 6.—Mazda fluorescent fitting incorporating "Permitol" capacitors

actual manufacture, a high standard of plant and handling cleanliness being necessary. For this reason the various stages in the manufacture of these capacitors are laboratory controlled. Fig. 5 illustrates apparatus used in the factory for checking samples of the impregnants, paper, foil and all other materials used in construction, and also for sampling checks during the actual process of manufacture.

The advent of this type of capacitor will assist in the design of lighting fittings. The appreciable reduction in size, compared with the petroleum jelly type, and the fact that it is also capable of safe operation at higher ambient temperatures, permits it to be mounted close to the choke and, therefore, the design of an integral choke-capacitor unit should be more readily accomplished. Fig. 6 illustrates a design of Mazda fluorescent lighting fitting incorporating the new "Permitol" capacitor.

Thermal Efficiency Improvement

Reheating with High Steam Conditions

IN a paper prepared for the Institution of Mechanical Engineers, Mr. J. C. London (Metropolitan-Vickers Electrical Co., Ltd.) investigates the improvements in thermal efficiencies obtainable with single-stage reheating at high steam pressures and temperatures over those previously worked out by Mr. K. Baumann and Mr. J. K. Finniecome for non-reheating conditions. These took into account the difference between the maximum thermal gain and the maximum economic gain, allowing for present cost of steel, cost of coal and its calorific value and the load factor.

As a common basis of comparison, 600 lb/sq in and 800 deg F are taken for both non-reheat and reheat cycles. The effect of varying feed temperature at different reheat pressures and with different feed-heating stages is shown by a series of curves. Gains in thermal efficiencies are plotted for stop-valve steam pressures of 900, 1,200, 1,500 and 2,000 lb/sq in gauge; losses when reheating to 50 deg F below stop-valve temperature are also shown. A typical feed-heating heat balance calculation for reheating turbines with steam conditions of 1,500 lb/sq in and 1,050 deg F is included in an appendix.

Effect of Pressure Drop

A pressure drop across the reheater of 10 per cent of the absolute pressure, it is stated, reduces thermal efficiency by 1 per cent, the loss being nearly linear up to 2 per cent for 20 per cent drop. Final wetness at 29in Hg is 6·4 per cent in a reheating plant with initial conditions of 1,500 lb/sq in gauge and 1,050 deg F and reheating to 1,000 deg F at 300 lb/sq in; a similar non-reheating plant has an exhaust wetness of about 12·3 per cent. Without wetness-loss correction, the thermal efficiency of the reheat cycle is 2·6 per cent higher than that for non-reheating, but with the full correction of 1 per cent for each 1 per cent mean wetness the improvement becomes 4·2 per cent. Drainage of one-third of the water reduces the advantage by 0·5 per cent. Gain due to reheating at 29in vacuum is reduced by less than 0·25 per cent at 28in.

Power for auxiliaries with non-reheating plant varies, with stop valve pressures of 600 to 2,000 lb/sq in gauge, from 4 to 6 per cent of the maximum turbine ratings for river cooling and from 4·5 to 6·5 per cent for cooling towers. With reheating the saving is about 10 per cent, improving the gain in plant thermal efficiency by 0·5 per cent.

Though the reduced steam volume flow with reheating tends to lower the thermodynamic efficiency ratio in the high-pressure portion of a reheating turbine, the lower leaving and exhaust loss results in a net gain in overall turbine efficiency; smaller condensing plant and boiler feed pumps are other advantages. For economy, the author concludes, it appears more logical to increase the rating of the reheating plant by 16 to 18 per cent, thus maintaining the same leaving and exhaust loss, expressed as a percentage of the available energy, as the corresponding non-reheating plant with the same stop-valve steam conditions.

Wenvoe Television Station

Serving South Wales and the West

THE new B.B.C. television transmitter at Wenvoe, near Cardiff, was opened on 15th August by the Postmaster General, Earl de la Warr, at the invitation of Sir Alexander Cadogan, chairman of the B.B.C. Board of Governors. This occasion marked the completion of the chain of five high-power transmitters which were planned to form the backbone of the B.B.C. Television Service, and from now on programmes will be available to 78 per cent of the population of the United Kingdom.

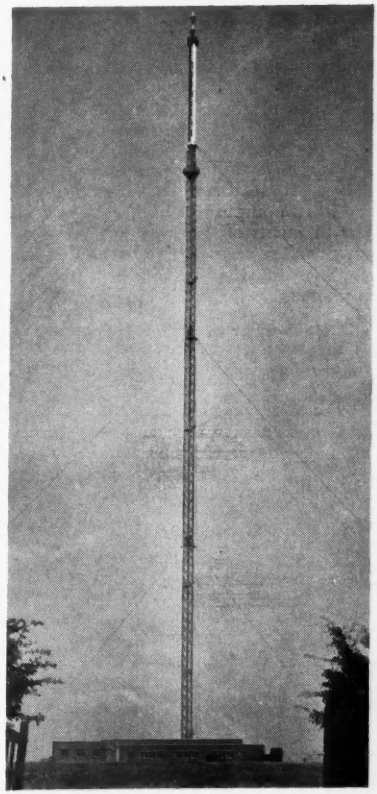
The new transmitter will serve both the West of England and South Wales. It is built on a site 400ft above sea level and the 750ft mast brings the total height of the vision and sound aerials to over 1,100ft, which is an important factor in securing the greatest possible service area. The vision programme is fed to the station by way of a coaxial cable from London (part of the Post Office television distribution network) while the sound programme comes over special Post Office telephone circuits similar to those used for other B.B.C. transmitters.

The vision transmitter, built by Electric & Musical Industries, Ltd., works on a frequency of 66·75 Mc/s. It is similar to the one at Kirk o'Shotts but different from those installed at the earlier stations at Sutton Coldfield and Holme Moss in that it uses low-level modulation. This new design has not only enabled a considerable reduction to be made in the physical size of the transmitter, but offers increased overall efficiency with a consequent saving in power consumption.

Incoming vision signals from London are first of all amplified and then applied as modulation to an early stage (i.e., at low level) of the chain of valves which amplifies the small radio-frequency output of a crystal oscillator up to the kilowatts required for transmission. The first stage in this chain merely amplifies the output of the oscillator. The second, to which the vision modulation is applied, consists of a pair of ACT27 air-cooled triodes giving an output of 600 W; the third is a similar stage producing an output of 3 kW; the fourth has a pair of ACT26 air-cooled triodes giving 12 kW; and the fifth and final stage consists of a pair of BW165 water-cooled triodes. The output of the transmitter is then passed to a vestigial-sideband filter, constructed of co-axial copper tube transmission line of 5in diameter.

High-voltage d.c. for the high-power

General view of the station and 750ft mast. Combined sound and vision aerial can be seen on the topmast surmounting the cylindrical section



stages is provided by oil-cooled metal rectifiers. One of the advantages of this type of rectifier is that the control circuits are simpler than those associated with the hot-cathode mercury vapour type which were used at Holme Moss and Sutton Coldfield.

Air for cooling the valves in the earlier stages is drawn from outside the building, filtered, and blown through cooling ducts. Two centrifugal-fan blowers are used, one delivering air to the transmitter and the other exhausting it by suction. Distilled water is used for cooling the valves in the final stage. It is drawn from a tank and circulated by a centrifugal pump through a multi-tube radiator (where it is cooled by air from a separate blower), through the valve jackets in the transmitter, and back to the tank. Contacts are provided in the main interlock circuit which ensure that the transmitter cannot be powered until the water flow is correct. A failure of the water-cooling system will also close down the transmitter.

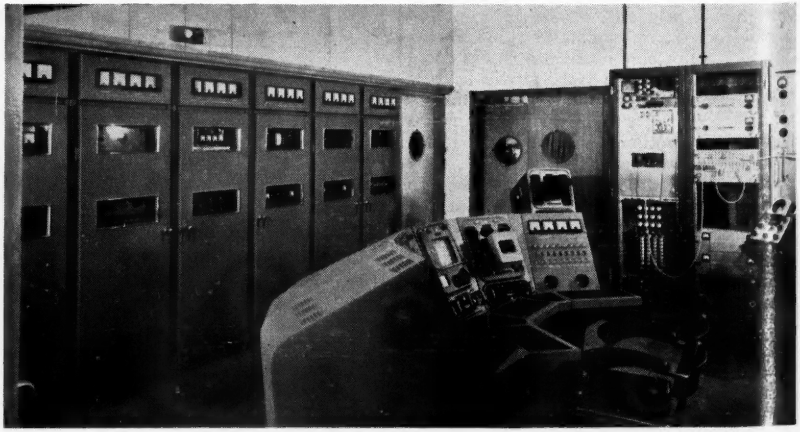
The high-power sound transmitter, made by Standard Telephones & Cables, Ltd., is of a more conventional type and the modulation is applied to the penultimate and final stages. It uses air-cooled valves throughout and has an output of 18 kW on 63·25 Mc/s. The filaments of the three radio-frequency power valves and the final audio-frequency amplifier are supplied with heating current from metal rectifiers, which are equipped with current-limiting reactances to control the filament current when starting up. All other valve filaments are heated by a.c. The main high-voltage supply is derived from a 6 kV three-phase full-wave bridge-connected rectifier.

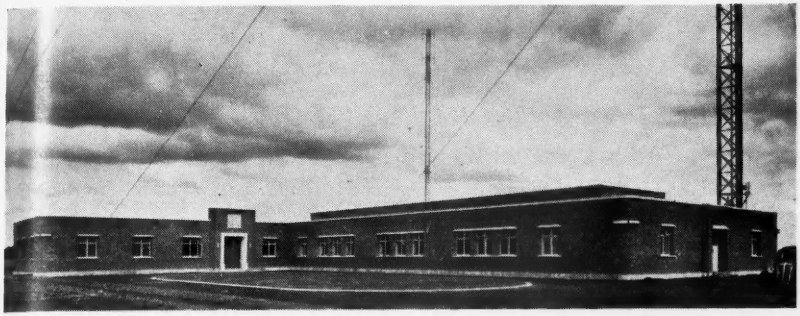
The outputs of both the vision and sound transmitters are fed into a combining unit. This consists of a "sound-pass/vision-stop" filter inserted between the sound transmitter and the common output and a "vision-pass/sound-stop" filter between the vision transmitter and this point.

From the output of the combining unit the signals are fed to the common aerial at the top of the 750ft mast. The transmission line used for this purpose is of a new design. It is a coaxial-tube type with an outer conductor made from 5in diameter copper tube. The inner conductor, however, is not a copper tube but a locked-coil wire rope, the outer layer of which is composed of wires made of high-conductivity copper. This rope, together with the outer tube, is suspended pendulum-fashion from the top of the mast. The wire rope is connected at the base of the mast to a loading mechanism so arranged as to apply a tensioning force of approximately two tons. It is located coaxially within the outer conductor by small rod insulators projecting from the inner surface of the tube at suitable intervals.

By suspending and loading the transmission line in this way the electrical

Medium-power transmitter hall showing control desk, test equipment and medium-power vision transmitter





Principal building with foot of main mast and the 150ft emergency mast and aerial

uniformity tends to increase towards the upper end, which is useful in reducing the formation of echoes; these echoes have the greatest time delay when the irregularities producing them are at the greatest distance from the transmitter.

The mast, built to a B.B.C. specification of structural requirements by British Insulated Callender's Construction Co., Ltd., is generally similar to those already in use at Kirk o'Shotts, Sutton Coldfield and Holme Moss. The supporting lattice steel mast is 600ft high and is triangular in section, each face being 9ft across. This is surmounted by a cylindrical section, 112ft high, having slots cut in its surface which may eventually form a very-high-frequency aerial for sound broadcasting. Surmounting the cylindrical section is a steel tower carrying the combined sound and vision aerials consisting of two tiers of four vertical dipoles.

SOUTH AFRICAN NOTES

From Our Cape Town Correspondent

THE Electricity Committee has recommended that the Port Elizabeth City Council should not agree to a suggestion that the second of two boilers destined for the new power station there be transferred to Cape Town. The question of transferring the boiler was raised by the Electricity Supply Commission, which stated that it would help to see Cape Town through the winter. The acting city electrical engineer pointed out, however, that the boiler could be replaced only by May, 1954, and the load on the Port Elizabeth system by the winter of 1954 would be such that both boilers should be ready for service at that time.

The electricity scheme at Walvis Bay, originally to cost £37,000, has expanded to such an extent that the capital expenditure involved is now estimated at £425,000. By December, 1954, the power station will have a gross installed capacity of 6,000 kW and the estimated consumption will be more than 6,000,000 kWh a year. In 1955 the scheme will make provision for an output of 7,025 kW.

In regard to a recent statement that the railway line between Bellville and Worcester will be operated with electric trains by the end of this year, a senior railway official now states that this will depend upon the prompt delivery of requirements from overseas, and as it is transformers from Britain and sub-station equipment from Switzerland have yet to arrive. Much of the other work in connection with the new line has been completed and the Hex River power station at Worcester will be able to meet all the power demands placed upon it. The initial installation in this power station, at an estimated cost of £3,600,000, includes three 20,000 kW 11 kV turbo-generators.

An electric "shocker" was used recently in the Bushman's River, in Natal, to catch trout and move them from one section of the river to another. A 220 V charge with a one-ampere flow was passed through the water and stunned the fish in the area. The stunned fish floated to the surface, where they were netted and put into tanks to recover before being transferred.

VIEWS on the NEWS

By REFLECTOR

A SUGGESTION has been made to the Board of Trade (reports the *Daily Mirror*) by Mr. Richard Levin that the British Industries Fair should be converted into the "British Industries Fleet." The idea is that there should be

> "five £1,000 a day charter ships with all the cabins —about 300 in each—turned into 'stands' for all the trades that normally show in the B.I.F. proper. Two more ships would act as floating hotels for staff and salesmen and for the entertainment of buyers. Cruises would last for six months every year."

I am sure that the proposal will have the hearty support of B.I.F. stand attendants even if their employers are not enthusiastic. In fact I myself would offer to take charge of the *Electrical Review* stand for one voyage at least.

* * *

I have every sympathy for the Kensington people who complain about the Borough Council's decision to provide only for gas cookers in a new block of flats. One lady who has just moved in refused to accept a gas cooker and was compelled to pay to have an electric cooker installed. She told the *Kensington News* that it seemed "very unfair that people who want gas cookers should get off free while people who want electricity, which is after all a far more modern method, should have to foot the bill themselves." This tendency on the part of a number of local authorities to favour gas is the outcome of the subtle (and sometimes not so subtle) anti-electric propaganda which has been so prevalent and in which, regrettably, Government Departments have taken a hand.

* * *

What is the "best thing in the Empire"? According to Professor A. E. Richardson, R.A., as quoted by "Peterborough" in the *Daily Telegraph*, it is the lighting just outside Brighton on the London road. Professor Richardson was discussing lamp posts, not things in general. I am afraid that when in Brighton I have not taken particular notice of this paragon, but Mr. H. Pryce-Jones, manager of the Mid-Sussex Sub-Area of the South Eastern Electricity Board, has given me some particulars. He says that it is a centrally-suspended cut-off system with lanterns containing three m.f. lamps, two arranged for switching off after midnight. The primary idea was to obtain satisfactory non-glare lighting for motorists with adequate road and pavement illumination and the avoidance of the unpleasant colour effects associated with discharge lamps—an important factor in a seaside resort.

* * *

"Long pig" was a term used by some cannibals to describe their horrible diet. But long pigs in the correct sense are proper food for human beings, and, according to the Department of Scientific and Industrial Research, the longer they are the better. Consequently it has been the custom of pig breeders to select those animals for rearing which have the greatest number of vertebræ (the number normally varies from 13 to 17). Selection has been by eye so far but although skill at this can be acquired by experience it is still not entirely reliable and a new technique has been developed by which piglets are subjected to X-ray photography. A portable equipment has been evolved which can be carried by one man and plugged into the ordinary electricity supply mains.

* * *

Looking through the property advertisements in *The Times* the other day I found one relating to a freehold cottage in Cornwall said to be "wired for electricity, which is outside." It set me speculating upon the circumstances. If there was an adjacent distributor why had it not been tapped? Had the owner altered his mind about electricity after having the house wired? Was there a small generating set in the garden? Or was the "outside" electricity going through a passing grid line?

PERSONAL and SOCIAL

News of Men and Women of the Industry

AT a meeting of the Belfast Electricity Committee last week, the post of city electrical engineer, caused by the resignation of **Mr. W. J. McC. Girvan,** with effect from 30th September, came up for discussion. The Committee, after a long debate, confirmed its previous recommendation that **Mr. R. P. Watson,** now acting deputy electrical engineer and manager, should be appointed as from 1st October, at a commencing salary of £2,300, the position to be reviewed at the end of a year. A motion that Mr. Girvan should be asked to reconsider his decision was defeated.

Mr. Forbes Jackson, M.I.E.E., M.I.Mech.E., who has been engineer in charge of the electrical division of the engineer-in-chief's department of the London County Council for about nineteen years, has been appointed deputy engineer - in - chief. Mr. Forbes Jackson was trained at the Chelmsford works of Crompton & Co., and after a period with the British Thomson-Houston Co. joined Messrs. Merz & McLellan in 1922, serving in their London office and in India. He joined the L.C.C. service as chief of the electrical division in 1933. During the 1914-18 war he was in the R.N. Divisional Engineers and served in Gallipoli and in H.M.S. *Princess Royal*. Mr. Jackson has actively participated in electrical installation matters as a member of the Post-War Building Studies Committee for Electrical Installations (Ministry of Works) and the Codes of Practice Committee (under the auspices of the I.E.E.) and has represented the I.E.E. on the National Register of Electrical Installation Contractors. He was chairman of the I.E.E. Installations Section in 1945-46, having previously been vice-chairman. He was a joint recipient in 1943 of the Swan Premium of the I.E.E. and of the Crompton Premium in 1946.

Mr. Forbes Jackson

Mr. P. Butler and **Mr. W. B. Laing,** joint general managers of Bruce Peebles & Co., Ltd., have been appointed to the board of the company.

Mr. R. R. C. Rankin, O.B.E., A.M.I.E.E., has recently been appointed technical manager of the Equipment Division of Mullard, Ltd.; he also holds the corresponding position in Mullard Equipment, Ltd. Mr. Rankin has a wide experience in the telecommunication field. During the later part of the war he was associated with the pre-invasion communication planning, and later at S.H.A.E.F. on the staff of the chief signal officer. Since the war he has been with Standard Telephones & Cables on transmission system planning. In the Mullard organization Mr. Rankin's duties will embrace a broad co-ordinating responsibility for engineering in all types of electronic equipment, both telecommunication and industrial.

Mr. R. R. C. Rankin

Mr. Frank V. Brook, chairman of Brook Motors, Ltd., is visiting Scandinavia at the end of this month, making calls on the Brook distributing agents in Oslo and Stockholm. He will also visit the St. Erik's Fair in Stockholm where a comprehensive display of Brook motors and control gear will be exhibited.

Mr. H. J. Finden, M.I.E.E., who is responsible for the development and design of electronic instruments in the Plessey Co., Ltd., is to read a paper on "Developments in Frequency Synthesis" at the conference on Instruments and Measurements being held in Stockholm from 22nd to 25th September. The paper develops the method of synthesis of frequencies previously described by the author and refers to equipment in which the frequency has been extended to 100 Mc/s. Consideration of the significant products of the mixing process

Mr. H. J. Finden

leads to solutions whereby the lowest order of harmonics can be determined. An equipment is described in which the selection of the correct frequency to be mixed is achieved automatically by motor driven harmonic selector switches controlled by manual digit dials. The purity of the output is such that all unwanted products are attenuated by at least 70 db.

Mr. J. F. O'Mahony, AssociateI.E.E., has been appointed area manager for the Benjamin Electric, Ltd., in Eire and Northern Ireland. Mr. O'Mahony, who will be resident in Dublin, was formerly on the engineering staff of the Electricity Supply Board from 1937 to 1945 when he joined the Philips Radio & Manufacturing Co., Dublin, as works manager.

Mr. A. R. Driessen, O.B.E., Eastern Branch manager of British Insulated Callender's Cables, Ltd., has been appointed commercial manager of the Indian Cable Co. and will leave for Calcutta at the end of the month. Mr. Driessen joined the former British Insulated Cables, Ltd., in 1944 as manager of the Ipswich sub-office. In the following year, after the merger with Callender's Cable & Construction Co., Ltd., this became a main branch office. Mr. Driessen had previously gained wide commercial experience in many European countries and had been the first manager of the electrical department of Flinders Wholesale, Ltd., Ipswich. He was a founder member of the Ipswich and District Electrical Association; he was chairman in 1939, and vice-president the following year. During the war he held a commission in the R.A.F. Volunteer Reserve for service with the Air Training Corps and was later appointed district inspecting officer for the Eastern Area with the rank of squadron leader.

Mr. A. R. Driessen

Sir Charles Goodeve, F.R.S., has been awarded £7,500 by the Royal Commission on Awards to Inventors for his part in devising means of combating magnetic mines during the war. Other awards include £5,000 to Mr. R. A. W. A. Lochner, £5,000 jointly to Messrs. S Butterworth, M. W. Burgess and N. F. Barber, £1,500 to Mr. S. L. Payne and £1,200 to Dr. A. B. Wood.

Mr. C. W. Coppinger, superintendent of the Glaucus Street, Poplar, generating station, has retired after 39 years' service in the industry. After experience at sea as an engineer Mr. Coppinger entered the service of the Poplar Borough Council in 1913 as a charge engineer and remained with it until vesting date, having been appointed to his present position in 1947. Presentations have been made to Mr. Coppinger by the controller and generation engineer (operation), London Division, B.E.A., from colleagues and superintendents in Group III and also from the Poplar staff.

Mr. G. E. Godfrey, M.B.E., A.M.I. Mech.E., has been appointed managing director of Brynmawr Rubber, Ltd., by the board of Enfield Cables, Ltd., of which Brynmawr Rubber is a wholly owned subsidiary. Mr. Godfrey took up his appointment on 1st August.

Mr. W. C. Sherry, manager of the Manchester branch of the Simplex Electric Co., Ltd., has retired after 32 years' service with the company. **Mr. F. N. Pardow,** deputy manager at Manchester, has been appointed manager.

Mr. W. J. Bentlett, telephone manager at Glasgow, has been appointed controller of the London Telecommunications Region of the G.P.O. He was formerly telephone manager at Middlesbrough. Mr. Bentlett is a native of Willesden and was educated at Kilburn Grammar School and the Regent Street Polytechnic.

Sir Donald Fergusson, Permanent Secretary to the Ministry of Fuel and Power, is retiring at the end of September. His successor will be **Sir John Maud,** Permanent Secretary to the Ministry of Education.

Mr. H. Pickup, senior assistant engineer (planning and development) in the Glasgow Sub-Area of the South West Scotland Electricity Board, has been appointed engineer of the Wakefield Sub-Area of the Yorkshire Electricity Board.

Sir Andrew MacTaggart has been appointed chairman of Balfour, Beatty & Co., Ltd., to fill the vacancy caused by the death of Mr. William Shearer and has also been appointed chairman and managing director of the Power Securities Corporation, Ltd., in the late Mr. Shearer's place.

Mr. H. G. Balfour has been elected chairman of the Jerusalem Electric & Public Service Corporation, Ltd., and the Perak River Hydro-Electric Power Co., Ltd., in place of the late Mr. William Shearer, and also a director of Balfour, Beatty & Co., Ltd. **Mr. Donald C. Brook** has been appointed vice-chairman of the Perak River Company.

Mr. A. Hall, A.M.I.E.E., has been appointed superintendent of Burnley power station and took over his new duties on 1st August. Formerly operation engineer at Burnley, Mr. Hall began as shift engineer at Colne in 1913 after serving his apprenticeship there. Before going to Burnley in 1923 Mr.

Hall had served with various municipal undertakings including Bury, Rochdale and Radcliffe.

OBITUARY

Mr. E. H. K. Brown, engineer of the Coventry Sub-Area, East Midlands Electricity Board, died on 3rd August at the age of sixty. Mr. Brown was a native of Coventry and before the nationalization of electricity supply was with the Corporation Electricity Department.

Mr. Brown, who was educated at Bablake School, Coventry, joined the Corporation Electricity Department in 1909. On completion of his apprenticeship, he entered the Mains Department as a junior engineer in 1914, and subsequently rose to the position of assistant mains superintendent from 1936 until 1942. He not only helped with the restoration of supplies during and after the many raids on the city, but took an active part in the undertaking's Home Guard unit. In 1942 he was appointed mains superintendent with control of substations and acted in this capacity until he became Sub-Area engineer in 1950.

Mr. K. A. Scott Moncrieff.—The death occurred on 5th August at Oxted, Surrey, of Mr. Kenneth Alexander Scott Moncrieff, M.I.E.E. He was eighty-three years of age. Mr. Scott Moncrieff was born at Dalkeith, Scotland, and educated at George Watson's College and the Heriot-Watt College, Edinburgh. After his training with Crompton & Co., Chelmsford, he became (in 1889) resident engineer of the Southend Pier electric tramway. Two years later he was appointed engineer to the Southampton Electric Light & Power Co. and then, from 1897 to 1901 was chief engineer of the Calcutta Electric Supply Corporation. He left India to become chief engineer of the Electric Supply Corporation, Ltd., a position which he held until 1934; he subsequently became chairman of the company.

Mr. Scott Moncrieff was formerly associated as chairman or director with a number of other electricity supply companies, including those in Cawnpore, Delhi and Madras, the Hendon Electric Supply Co., the Northmet Company and the East African Power & Lighting Co. He was a past-chairman of the Provincial Electric Supply Association and the British India Electricity Committee.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Light Gauge Conduit

MR. BUCKLEY'S letter in the *Electrical Review* of 8th August brings back memories of long ago while I was carrying out installation work on the Continent with the type of tubing referred to.

This was the Bergmann tubing, made in various sizes; those I remember off-hand being 11, 16 and 20 mm. The conduit consisted of two tubes, the outer one of lead-lined zinc and the inner one a cardboard composition wound in tape form similar to the paper insulation of cables. The whole was impregnated with bitumen, forming a complete insulated inner tube with metal protection on the outside. The seam of the tube was quite prominent by the double fold-over.

All types of junction boxes were also available, similar in construction to the tubing. On joining tubes or entering junction boxes about ½in of the zinc portion was removed, leaving the insulating part only for the protection of the cables. When the tubes were inserted into position heat was applied, the bitumen running to form a damp-proof joint and retain it in position.

Wiring was enclosed in the tubes before erection or bending. This was necessary as it did not make a perfectly drawable job and it was not difficult as in those days joints were made in all junction boxes as the loop-in system was not employed. The jointing was carried out in a proper manner by soldering and applying rubber insulating tape, etc.

For concealed systems the tubing terminated at ceiling level and for switch drops a slight set was made in the tube to bring it to the plaster surface, in which case the zinc portion was removed and made ready for accommodating wooden blocks.

The supply voltage was 110 V a.c./d.c. for lighting circuits and 220 V for power. Different setting or crimping tools were

required for each size of tube. They consisted of large size pliers, one size being a semi-circular groove crescent shape, while the other was provided with a centre knife making indents similar to the pattern of a stove-type bend.

Very little trouble was experienced with this type of insulation, even on concealed work. Perhaps test requirements were not so stringent in those days. No earthing was necessary as the wiring was not in touch with any metallic part. As previously stated, even the junction boxes had an inner insulated lining.

*London, S.W.*9. H. F. HUGGINS, M.A.S.E.E.

London's Trams

OWING to holidays, I have only just seen Mr. Waterer's letter in your issue of 25th July. The Metropolitan Police records do not support his contention that the accident rate has declined since the trams were taken off; the figures for Camberwell were 5·4 accidents per mile of road in 1950, 6·1 in 1951 (one tram route through Camberwell was withdrawn in October, 1950, six more during 1951). The accident figures for Battersea (from which all trams disappeared in October, 1950) were 4·9 per mile in 1950, 5·3 in 1951. These records show that the accident rate is much higher in non-tramway boroughs such as St. Marylebone (11·6 per mile) and Hammersmith (8·9 per mile) than in the predominantly tramway operating boroughs (during 1951) of Greenwich (4·6 per mile) and Lewisham (5·0 per mile).

The Metropolitan Police figures do not show crossing roads to board trams as a major cause of accidents, although all causes are carefully analysed. In any case, such accidents could have been almost eliminated by greater use of loading islands.

I quite agree that the conduit system was a great drawback, and I cannot see that there were any æsthetic reasons for its retention except perhaps, on the Victoria Embankment and over the bridges, where the trams being on reserved tracks, a type of conduit with a wider slat which would not have required change-pits could have been used.

I have not observed the improvement in traffic conditions Mr. Waterer claims: as a cyclist I find conditions much worse, with buses constantly interpassing. Colleagues, who formerly opposed trams, admit that they now have to wait much longer in the queues.

A complete network of underground railways would be fantastically expensive to construct, and less convenient than a system of surface light railways alongside the main highways with short subways under busy road intersections.

To cope with the volume of modern traffic either roads must be widened or tunnels built beneath them. In many cases where roads are flanked by decaying property or by houses with long, neglected gardens (e.g., Brixton Hill), widening would be cheaper, but it would be cheaper to tunnel beneath important business and shopping centres. Only the light railway using modern single-deck cars, which have been so successful in Continental countries, can be adapted to operate under either condition.

F. K. FARRELL, B.A., A.M.I.E.E.
*London, S.W.*11.

Atlantic Cable Restored

THE restoration of Cable & Wireless, Ltd.'s direct cable across the North Atlantic from Portheurno, near Land's End, to Harbour Grace, Newfoundland, was completed on 6th August. This cable was laid in 1874. It was interrupted in 1943 but it was not possible to repair it because sufficient cable to bridge the length of the fault was not available owing to the war and resultant shortages. After the war, restoration of the war-damaged cable system in the Far East took precedence, as the company still had a transatlantic cable link in operation.

The cable ship *Monarch* left London on 14th July to carry out the renewal. She had in her tanks 1,300 miles of cable of the latest types. Eight hundred miles of the original Atlantic cable have been renewed. It is hoped to renew the remainder of the cable next year. The *Monarch* will now renew 400 miles of the cable joining Harbour Grace to the Canadian mainland at Halifax, Nova Scotia. The total cost of these renewals is expected to be £1,900,000. Mr. J. A. Smale, engineer-in-chief of Cable & Wireless, Ltd., is directing operations from his London office.

Fuel Efficiency Exhibition

AT a meeting in Manchester called by Provincial Exhibitions, Ltd., it was agreed to hold a second Fuel Efficiency Exhibition in Manchester in November, 1953. An advisory committee was nominated under the chairmanship of Mr. F. W. Woodfield (Babcock & Wilcox, Ltd.).

A Coming of Age

Some Comments, Facts and Fallacies

By T. C. GILBERT, M.I.E.E.

THE voltage-operated earth-leakage circuit breaker has now been with us for about twenty-one years.* The intervening period has been filled with theoretical discussions, impractical suggestions and undeserved condemnation of this device, with, nevertheless, a large measure of successful application that has resulted in voltage-operated protection being now an accepted part of good practice. Even to-day, however, there is considerable difference of opinion regarding the most effective ways of securing adequate protection with the device, and the writer is tempted to try to extract some grain from the chaff (in both senses of the word!) and resolve the clouded atmosphere.

The device has been accepted as a means whereby leakage voltages, likely to come into contact with an appliance user, may be isolated before they reach lethal values, especially in situations of poor earthing conditions. With this object in view manufacturers of early equipment strove to reduce the voltage of operation to excessively low values. The main result was the production of unduly sensitive equipment with high reactance trip coils which, in many cases, did not survive the first good lightning flash in the vicinity. In 1939, however, the issue of B.S. 842 set the voltage of operation at 24 V against an electrode resistance of 200 ohms and 40 V against 500 ohms, the operating current to be not less than 15 mA. The comparable German requirements were 22 $\pm$ 2 V against 200 ohms and up to 65 V against 800 ohms; operating currents were generally greater than in this country.

Prior to that date the device had got off to a bad start by the requirement in the 10th edition of the I.E.E. Regulations concerning a leakage protective device operating with a current not exceeding 30 mA, voltage of operation being ignored, which brought it into the category of just another current-operated protective device. The effects appear to persist unto this day and many engineers continue to advance views and consider applications based upon current operation, so that many misleading conclusions are reached and the device is omitted from installations wherein its inclusion would not only be justified but is imperative. I hope to touch upon one or two of these fallacies later on.

Operating Conditions

The perseverance of some manufacturers in marketing devices claimed to operate at voltages below those indicated by B.S. 842 is, in my view, mistaken and, as mentioned above, can only result in unduly sensitive and unreliable equipment. Again in my view, the important clause in B.S. 842 is not that relating to voltage of operation, or to maintenance of operating current above an unduly low level, but the requirement that the device shall operate within 0·1 second (Para. 18 (vii)). If this speed of operation can be ensured, it must matter very little if the voltage of operation (that is, possible leakage voltage for accidental contact) be 30 or 300 V as it will persist for too short a time to form any menace to man or beast. The first requirement for a voltage-operated leakage circuit breaker is absolute reliability and too rigid an adherence to actual values of voltage of operation is a secondary matter.

It is therefore gratifying to note that leading manufacturers of these devices—leakage trips, to give them their popular name—now incorporate trip coils with robust windings which, although operating within the voltage limits set by B.S. 842, employ operating currents up to 75–85 mA and the tendency appears to be to go even

*First demonstrated to a sub-committee of the Wiring Regulations Committee of the Institution of Electrical Engineers by the author on 27th November, 1930.

higher. This is all to the good if reliability and speed of operation be thereby improved and I would shed no tears if voltages of operation were also to be increased, against specified electrode resistances, with the same object in view. The initial voltage appearing upon metal casings in the event of a complete, or partial, earth fault appears to be much higher than shown by calculations, or surmise, even if it does not reach full mains voltage. This can often be convincingly demonstrated by rigging several leakage trips to cover the same circuit, but adjusted to trip say between 20 and 200 V, for operation with an impedance representing electrode resistance in circuit; with the momentary application of a direct earth fault all trips normally come out simultaneously.

It is held that a leakage voltage may grow from a small value to a greater, and that it should be isolated before it reaches a dangerous value. I do not subscribe to this idea and consider it due to confusion between voltage and current in earth faults; if it were true, it might be expected that the trip with the lowest voltage setting in the experiment described above would operate first, before the higher settings. If, on the other hand, fault voltage starts high and possibly falls to some lower level owing to circuit conditions, as is indicated by the experiment, it is clearly unnecessary to concentrate upon low voltages of operation for leakage trips. However I hesitate to be dogmatic about this, or any other aspect of voltage-operated protection for that matter since on one unforgettable occasion when the experiment was being tried before a distinguished audience the trip with the lowest setting *did* come out, all alone, to our utter confusion.

Time Element Important

There must obviously be some limit to voltage of operation against specified electrode resistances in a standardized article, but in my view no harm would be done by a raising of these voltages in relation to resistance values normally found in rural areas, say round 60–100 ohms. It could go up to 60 or 80 V, with operating currents of 150 mA, provided that operation within about 0·1 second could be ensured. In all matters affecting fatalities from shock it is the time element that is of fundamental importance, not meticulous attention to actual values of voltage or current suffered by the victim. If the leakage potential can be isolated within a fraction of a second, danger cannot arise whatever the p.d. may be.

The apparently high initial voltage set up by an earth fault has posed many problems regarding the use of leakage trips for sub-circuit or final sub-circuit application. As has been pointed out above, differential trip settings are abortive, as all trips may operate simultaneously. The E.R.A. report F/T122, issued in 1940, went into considerable detail in describing means for isolating sections of a conduit wiring installation whereby sub-circuit trips could be made to operate with discrimination; it was, however, a purely theoretical approach and in my view impracticable. While it is always possible to isolate individual conduit runs from one another, it is extremely difficult to isolate them from the building itself; it is always possible for several conduits to touch the same steel joist, or reinforcing bars, or even be connected by damp concrete, and thus defeat the careful installation of insulating bushes at junction boxes and distribution boards. However, sectionalizing of earth paths can be carried out with success in certain applications, as will be seen later.

In my experience reliable sub-circuit application of leakage trips is only possible with insulated wiring systems, with the earth continuity conductor also enclosed under the insulating sheathing, or within the non-metallic conduit, in order to prevent any contact with extraneous metal-work or other earth continuity conductors. Where such wiring systems are used there is not really any problem, but an added degree of reliability can be ensured by the use of small individual earth electrodes rather than water or similar pipes. Even with insulated wiring systems discrimination can sometimes be destroyed by using only one electrode for all the trips unless there is due recognition of the possibility of parallel earthing, intentional or fortuitous, of the protected equipment.

For instance (Fig. 1) consider a motor A, metallically connected to a pump and suction pipe, energized through a leakage trip for protection, with the earth connection made to a local electrode; motor B for another machine is also energized through another leakage trip, but its earth connection is made to the electrode serving motor A. At first glance it would appear

that both motors were adequately protected by their individual trips; so they are, but very inconveniently in that both trips will probably operate with a fault on motor B, due to the suction pipe probably being a more attractive electrode than the driven spike installed for the purpose. The high initial voltage impressed upon the casing of motor B spans both trip coils, in series, completely ignoring the earth path provided by the special electrode. This actually happened in practice, but the difficulty was removed with the installation of a separate electrode for each trip.

Parallel Earths

The possibility of short-circuiting the trip by means of fortuitous earth contacts elsewhere has puzzled many prospective users, especially if current operation has been foremost in their minds. The latest edition of the I.E.E. Regulations has some useful notes on the point, Note 4 to Regulation 1006, but it is sufficient to say that where leakage trip protection is employed it normally does not signify whether leakage current passes over a dozen different points. We are only concerned with the appearance of leakage voltages, to which the trip is responsive; if the parallel earths can dissipate the leakage current and isolate the fault by means of the fuse, then there is no need for the trip to operate. One can be sure, however, that if the leakage persists a voltage will invariably be set up and then the trip will come into the picture. The Regulations advise the insulation of the earth wire between the trip terminal and its electrode; although this is not always necessary, it is a useful precaution. More will be said concerning the possible short-circuiting of the trip in connection with water heaters later on, but it can be pointed out now that the placing of a second resistance in parallel with an existing one "short-circuits" neither of them; some alteration of current flow with the setting up of varying voltages may occur, and I have never yet found a fortuitous earth of negligible resistance.

Parallel earths may even be intentional. The Factory Department of the Ministry of Labour and National Service, for instance, will not approve leakage-trip earthing by itself, but requires the backing up of direct earthing in addition. Theoretically, this arrangement has something to commend it in that the main protection is undertaken by the solid earth, the trip being left in the background until some failure of the solid earth arises like disconnection or high resistance. I have two serious objections to the practice, however, one being the possibility of the trip earth being installed within the sphere of influence of the main earth electrode—a point mentioned in the I.E.E. Regulations, No. 1006, Note 4—or even actually connected to the main earth electrode, which has happened in practice. If this happens, then operation of the leakage trip is rendered unlikely, as its trip coil will be subjected not to the difference between the protected casing and earth but to certain values of voltage drop down the main earth connection. This will be dealt with more fully later, in connection with water heaters.

The other, possibly more serious, objection is that with the use of a parallel earth any simple and easy test *from the equipment itself* is precluded. The test key on the device itself is not rendered ineffective, but this fact tells only half the story; I am "sold" on the idea of testing protective equipment under actual fault conditions, and with leakage trip earthing alone it is usually possible to short over the phase to the appliance casing and bring the trip out as a check of the earth continuity conductor right down to the electrode. One would hesitate to make this test with a designed parallel earth connection in being, however, although it is done in Ireland; but there they check all earth connections by blowing fuses in this way, a practice much to be commended.

This matter of periodical test and check

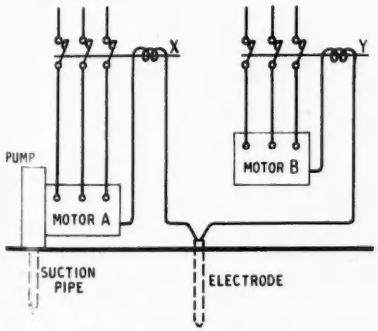


Fig. 1.—**Probable loss of selectivity due to use of one common electrode for trips X and Y**

is of the utmost importance. Circuit conductors give notice of failure in obvious ways, but protective circuits require occasional examination. Factory Department inspectors know better than others how often this need is neglected in practice, judging from successive annual reports constantly urging " loop " and similar tests upon industrial consumers. The leakage trip is a fairly delicate piece of equipment and, in common with direct earthing, is dependent upon its earth connection remaining intact if it is to perform its protective function. For both of these reasons the device is equipped with a test key, checking both mechanism and main earth connection, but this is clearly ineffective unless the key gets pressed once in a while. It thus follows that trips should invariably be in accessible positions, near the equipment controlled. Details have lately become available of a fatality associated with an installation that was fitted with a leakage trip; it was found that the earth connection had failed by reason of corrosion. The trip itself was high up on a wall where occasional tests could only be carried out by means of a ladder. I am extremely interested in various proposals designed to make such checks automatic, from the protected equipment itself down to the electrode, but whether we in this country would be prepared to go to the lengths advocated in a German publication, with the arrangement shown in Fig. 2 in which the switch on the standard lamp tests the earth connection through its own lamp, is doubtful.

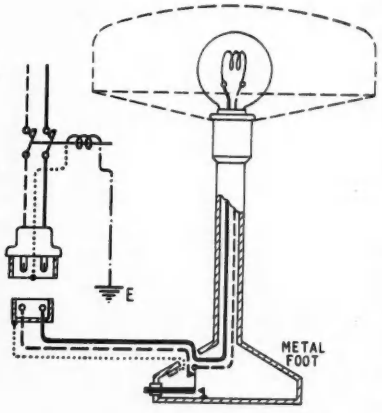


Fig. 2.—Semi-automatic check of earth circuit with standard lamp; an artificial fault is impressed upon the frame, through the lamp, by pressing the key switch in the metal base

It appears to me that this checking is an essential contribution to reliability and that unless it can be ensured then leakage trips might as well be scrapped. In domestic installations individual trips covering cookers or washing machines can be kept under check by persuading the users to press the test key instead of the normal " off " button in order to switch off—they will soon notice if anything is wrong. It is agreed that this action checks only part of the circuit, but it is the most vulnerable part; without occasional check, however, the protection afforded by leakage trips can rank no higher than haphazard direct earthing, with which these essential connections are rarely, if ever, tested—or at least in a form simulating an actual fault. In my view reliability postulates accessibility, not the placing of leakage trips in metal boxes fitted with padlocks, as has been recently observed.

Local Leakage Trips

Much has been written and said regarding the use of one central leakage trip *versus* local trips for individual appliances. With farm installations it may often represent considerable economy to use local trips, as an earth continuity conductor need not be provided all round the farm; local trips can be connected to local electrodes. From the wider aspect of efficient protection the use of individual trips appears to be essential, as it is the only way to prevent the extension of leakage potentials all over the place (on water pipes, metal frameworks of buildings and associated equipment) which has been a prolific source of accidents to cattle in the past owing to the extension of leakages from faulty equipment to all other equipment on the same continuity conductor. The trip can form the main controlling switch for the protected equipment, with the user again trained to switch off by the test key. Additional reliability can be achieved by getting away from the conventional use of a driven pipe or spike as an electrode. I was attracted by the simple means used on many German farms, where a few coils of galvanized wire were buried a foot or two down, with one end taken up into the earth terminal of the trip.

One vulnerable screwed or bolted joint is thus eliminated and it seems that even old barbed wire can be pressed into service here—the rustier the better!

Reverting to the matter of parallel earths, it is often said that the leakage trip cannot be used for the protection of water heaters, as it is shorted-out by the direct connection of the cold water feed pipe. This rather begs the question as to whether a pipe of this kind does represent any sort of low-resistance shunt because, far from being a direct path to earth, the feed pipe usually passes to a storage tank, a common practice with water heaters. Normally this pipe passes through a cut hole in the tank, secured by means of lock nuts on either side of the tank wall, well grouted with red lead and tow. The main water supply to the tank *may* pass also through the tank wall and thus be in some sort of metallic connection with the feed pipe, but quite often it merely appears over the top, without direct connection to the tank. It cannot be denied that water heaters, in view of their probable situations over sinks or baths, require adequate leakage protection; an appreciation of the position is shown in Fig. 3.

Taking the best case, when the main pipe is attached to the tank wall, there are thus two joints in series in the earth connection and it will be assumed that they offer no greater resistance than one ohm. Normally the installer measures the resistance from the water heater to a second connection made to the *incoming water main* and thus any electrode resistance is left out of account; even one ohm, however, does not represent a short-circuit in the accepted sense of the word and it becomes a shunt circuit across the leakage trip.

Resistance Variation

Now I will advance a contention that will most likely be received with scepticism: it is that an ohm is not always an ohm! The resistance of pipe joints of the kind shown in Fig. 3 appears to vary according to the magnitude of the testing current; if measured by the ordinary battery-operated ohmmeter it may appear to be no more than one ohm whereas a test of the same circuit with 10 or 15 A may indicate that the resistance has suddenly increased to 4 or 5 ohms. The easy explanation is that local heating at the joint is responsible for the apparent difference, but against this the fact can be observed in very short-period

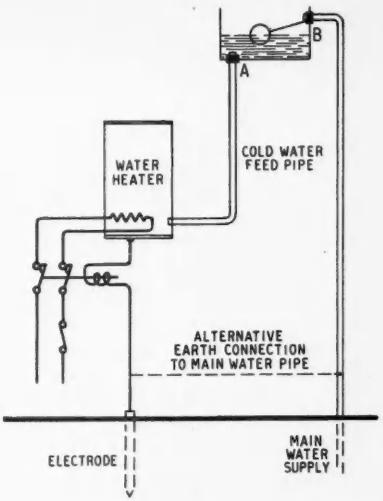


Fig. 3.—Voltage-operated leakage protection applied to water heater; the separate electrode should be used, not the connection to the main water supply pipe, as A and B are possible sources of resistance

tests, although it is emphasized in long-period tests. I have noted this phenomenon several times and it has considerably shaken any reliance upon recorded figures relative to earth paths and electrodes; it also explains the extreme pessimism with which alleged resistance values are accepted, as it is safer to assume that they are much higher than simple figures show. Although this theory may shake Ohm's Law to its foundations, the fact remains and it has possibly been observed by others. In any case, protracted leakage currents must always be accepted as probable in connection with electrodes, so that a simple ohmmeter test is valueless.

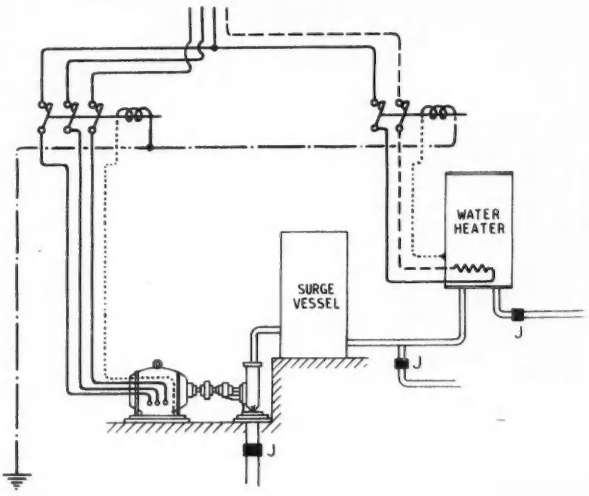
Taking the best case of the arrangement in Fig. 3, however, it will be assumed that the element is connected to a ring circuit through a 13 A fuse—the 7 A fuse will be too small unless the element loading is no more than 1 kW—and this fuse may require 20 A to cause it to blow. Again from the assumption that the shunt earth path represented by the cold water feed is of no more than one (actual!) ohm, with the trip connected to the main water pipe for its electrode, it can be deduced that immediately before the fuse blows the trip

coil will be exposed to about 20 V; the trip is, however, almost certain to function before the fuse blows, as I have observed, even with experimental trips set up well beyond the voltage limits of B.S. 842. It must be emphasized, however, that these experiments are carried out under practical conditions; it is by no means certain that similar results would be obtained with carefully graded non-inductive resistances shunted across the trip in the same way.

I deprecate the purely mathematical approach to voltage-operated devices, as it may be dangerous and misleading. In practice reliable protection is often ensured by leakage trips installed in defiance of apparent "short-circuiting" parallel earth paths, as can be checked by those willing to test directly-earthed objects with a trip in parallel because the imposition of an earth fault operates the trip. I should, perhaps, be cautious here, as on one occasion it didn't! However, should the fuse blow instead it would at least have demonstrated that the direct earth was adequate; let a few ohms creep in or an oversize fuse be fitted, however, and the trip will assume responsibility for isolation. In all cases when this trial is made an independent electrode should be used for the trip and it should not be connected to the electrode used as the direct earth; independent electrodes are advisable for the arrangement shown in Fig. 3, too, as likely to ensure greater reliability of operation. I ascribe the operation of trips under apparently short-circuited conditions to the fact that the initial voltage appearing upon the equipment is higher than calculated; I have shown that a trip operating in 0·1 second is faster than a fuse blowing in 0·006 second—more scepticism, no doubt!

It has been suggested that under the conditions of Fig. 3 the trip operation would be made more certain by the insertion of a short length of non-metallic piping in the feed. This rather betrays the "current-operated approach," but might be of advantage when selective operation between various circuits is required, although it is doubtful. The proposal has the support of writers on voltage-operated methods in the German technical press; although I quote some of them on occasion, their recommendations should not be accepted blindly for even in that country some confusion seems to prevail. For instance, Fig. 4 shows a suggested arrangement to secure discrimination between the leakage trips covering a pump motor and the element of a water heater, taken from "Anleitung fur die Anwendung der Schutzschaltung," sponsored by Heinisch himself, one of the men concerned with the original development of the leakage trip. I am very doubtful if this arrangement would work, but it might have been made more effective by the placing of the insulating sections in the pipe connecting the "wind-vessel" and the water heater rather than in the warm water pipe, although even then the potential impressed upon the water columns in the pipes might lead to loss of discrimination. I would prefer an insulated coupling

Fig. 4.—Suggested arrangement for securing selective operation between two leakage trips by the insertion of insulating sections at J, J, J, but unlikely to be effective because voltage may be impressed upon the water columns themselves



between the motor and the pump and the omission of all the insulating sections in the piping as being more likely to secure the desired discrimination between the two trips. Note the separate independent electrode, which is an essential feature of all Continental applications.

An insulating section in the feed pipe would probably be of advantage in case of a high-resistance earth fault, say occurring at some point in the element winding. With a fairly low resistance path through the feed pipe leakage current could continue to flow indefinitely, being neither heavy enough to blow the fuse nor to ensure the requisite voltage to operate the trip. An insulating section in the pipe would build up the leakage voltage almost immediately, however, owing to drop down the water column and thus ensure the operation of the leakage trip. The paradox thus appears that the worse the parallel earth the more likely isolation is to take place, which is yet another argument against the designed parallel arrangement of direct earth and trip; a good solid earth cannot be expected to isolate a high-resistance earth fault, but by its very goodness it prevents the trip doing so. There is thus something to be said for the introduction of resistance into every earthing circuit, but as it usually appears fortuitously there seems nothing we need do about it officially.

All d.c. applications of leakage trips must be confined to interrupting no-volt, hold-on, or similar operating coils of small current demand, as the contacts and breaks of standard leakage trips are rated for a.c. It has to be remembered that trips are more voltage-sensitive to d.c. since there is no reactance of the coil winding and the standard trip may operate with no more than 8–10 V d.c. Adjustment is sometimes necessary in connection with excessive leakage from cooker hotplates, but the latter do not constitute faults.

Prospective users of leakage trips can obtain a more complete overall picture of the conditions of voltage-operated leakage protection if it be remembered that at all material times, as the lawyers say, the consumer handling equipment in which there are metal casings is himself placed in parallel with the trip coil and electrode, forming a shunt circuit across them, so the leakage voltage impressed upon him will approximate to that available to operate the trip.

Many hitherto "insoluble" leakage problems are resolved if the full implications of voltage operation are appreciated. Attempts have been made to eliminate shock risks from aluminium houses and steel farm buildings by means of expensive direct earth connections, especially in areas where non-metallic water mains have made their appearance, whereas all that is necessary is to include the framework of the house within the protection afforded by the leakage trip. In such cases, however, the electrode must be remote from the building, say 8 to 10ft away, with the actual earth connection to the electrode encased in non-metallic conduit run underground. For reliability, galvanized iron wire may be used from the trip terminal to form its own electrode by means of a few coils buried a couple of feet down; the insulation finishes where the coils are commenced. Old copper conductor is equally suitable, but all joints between an earth wire and the electrode should be eliminated.

To sum up, I would offer the following points for consideration by prospective users of leakage trips:—

1. Select a device for its simple and robust construction, without complications, as reliability of operation is of greater importance than meticulous concentration upon close voltage limits.
2. Install leakage trips in accessible positions and ensure that the test key is pressed upon every possible occasion; unchecked protection is a delusion and a snare.
3. Remain absolutely unconcerned about the possible parallel earth path; its resistance will invariably be higher than is thought, or simple measurements indicate.
4. Avoid at all costs the involved mathematical approach to leakage problems, as it can be very misleading. Try the proposed arrangements out "on the bench," or, better still, on the site; the results may be very surprising.
5. Avoid complicating the device by thermal or magnetic overload trips, or reliance upon *anything* for operating the trip except leakage potentials: overload protection can usually be efficiently ensured by means of the circuit fuses.
6. Sub-divide leakage protection as far as possible: one trip to each appliance is the ideal, but possibly an unnecessary one with normal applications.

I am convinced that, with logical consideration and intelligent application, the leakage trip can solve all leakage protective problems.

CONTRACTS AND SALES

*2—Terms and Conditions**

By C. F. MAYSON, A.M.I.E.E.

IT is important to be able to differentiate between a contract for the sale of goods and one for work and materials, for the Sale of Goods Act, 1893, governs the former, whilst the latter depends almost entirely upon the common law, and in some respects the rules are not the same. The sale of a lamp is obviously a sale of goods, as is the sale of a fire, even though it may have to be fitted with a flexible and plug to suit the customer. On the other hand, a rewind or other repair to a motor is work with the incidental supply of materials (e.g., wire, tape, etc.), and is not within the Act. The erection and installation of a switchboard would be a sale, but whether a wiring installation is a sale or work is uncertain.

It used to be said that the test was whether or not there was a transfer of property from the seller to the buyer, but later judicial opinion has it that it is the essential basis of the contract which matters: is the customer paying for the exercise of skill or for a finished product? Little assistance is to be got from decided cases. The best solution (which may easily be wrong) seems to be that a wiring installation is goods, on the basis that the work of installing is merely an assembly of items, the essence of the contract being the supply of the material.

Implied Terms

There are certain terms implied in every contract, whether or not they are actually expressed. A person who holds himself out as an electrical installation contractor is expected to exercise skill and care to the standard normally accepted in the trade, and he is vicariously responsible for the workmanship of his employees. Further, if he does work or supplies goods for a particular purpose of which he is aware, there is an implied condition that the workmanship and goods will be fit and suitable for that purpose.

Suppose you are asked to supply a motor to drive a machine and, though the customer has omitted to mention it, you know that there is a certain minimum h.p. required to give satisfactory operation of that machine. It is reasonable to suppose that the customer is relying upon your skill and judgment, and you will be at fault if you supply a motor rated at below the minimum. There is no such implied condition, however, when goods are asked for and supplied under a trade name which is in itself a sufficient description. For example, an order for "fittings of X.Y.Z. manufacture" restricts you to that maker, but your skill and judgment are still relied upon; to be asked for X.Y.Z. "London" fittings, however, might leave no room for any choice on your part, and the exercise of your judgment would not then be required.

Similar conditions apply to repair work where the whole or part is put out to another firm. In a very recent case it was held that a "repairer is liable for defective work on the part of his sub-contractor, even if the customer consents to the work being done by that sub-contractor, unless the customer, without placing reliance on the skill and judgment of the repairer selects a particular sub-contractor by whom the work is to be done."†

Other implied terms apply to the sale of goods only. Goods must be of "merchantable quality," that is, they must be of such quality and condition that a reasonable person would accept them after a normally careful examination. This term applies whether or not the goods are sold under a trade name, but is excluded, as regards discoverable defects, when the buyer himself, or his agent, actually examines the goods, as in a sale "over the

* Part 1 on "Formation of the Contract" appeared in the *Electrical Review* of 8th August, pp. 297–9.

† *Stewart* v. *Reavell's Garage* (1952) 1. *The Times* Law Reports, p. 1266.

counter" (an example of *caveat emptor*—"Let the buyer beware!").

When there is a sale by sample, the bulk must correspond with the sample in quality. Should the sample be accepted, the buyer cannot afterwards reject the bulk because of defects which were reasonably apparent in the sample but not detected by him. If the sale is by description only, the goods must correspond with the description; if they do not, they may be rejected. But where the sale is by sample as well as description, the goods must correspond with both.

Conditions and Warranties

The words "condition" and "warranty" are often used as meaning the same thing, but in law there is a difference which can have important consequences. A condition is a term directly affecting the purpose of a contract, and breach by one side entitles the other to repudiate. A warranty is an auxiliary stipulation in the nature of a guarantee, breach of it entitling the aggrieved party to a claim in damages only. Whether a particular term is to be treated as a condition or a warranty depends almost entirely upon the purpose of the contract and the true intentions of the parties. It is therefore difficult to set out any rules.

The implied terms already referred to are conditions, those applying to goods being specifically designated as such in the Sale of Goods Act. Statements as to quality of goods are usually treated as warranties, unless the absence of that quality is sufficient to make the goods substantially different in kind, when they are obviously conditions. A specification for ironwork to be "hot-dip galvanized" does not contemplate any other form of galvanizing, though for the purpose in view "hot-dip" may not be essential. If the goods are supplied galvanized by some other process, there is a difference in quality but not in substance, and that constitutes a breach of warranty only. On the other hand, to supply hard-drawn copper wire instead of annealed when the latter is asked for would be a breach of condition, for the two are different in kind.

An aggrieved party may, if he wishes, treat a breach of condition as a breach of warranty and claim damages in compensation. Such a claim is not barred by a clause in the contract providing that action shall not lie for breach of warranty, for the claimant is in fact suing for breach of condition, though he has forgone his right to repudiate.

Express Terms

Every contract, whether oral or written, contains a number of express terms inserted by agreement between the parties at the time the contract became executory; such terms cannot be inserted subsequently unless forming part of a supplementary contract. In interpreting express terms, the intention of the parties as disclosed by the language employed is what matters, and not what they may have had in their minds at the time. If the contract is in writing, the meaning is to be gathered from what is actually written, not from what might have been written. Language is given its ordinary popular meaning, unless a different one is obvious from the context; no external evidence is allowed as to what was meant to be said, but was not expressed, at the time. However, technical expressions and those used by custom in particular trades are allowed to be explained.

Implied terms may be expressly excluded, and standard clauses may be included by reference. A number of firms use standard "Conditions of Sale" in printed form, which embody clauses common to many contracts, covering such matters as payment, delivery, packing charges, etc. It is most important that such terms are expressly embodied in the contract as though they were actually reproduced. This is sometimes forgotten by those who use printed estimate forms with the conditions of sale reproduced on the back, for, unless those conditions are specifically referred to on the face of the estimate itself, it is doubtful if they have any force.

Care should be taken to see that no clauses in the written estimate run counter to the printed conditions (unless it is intended that way), as the writing, or typewriting, overrides the printing. Difficulty may arise when an estimate on a printed form is accepted by an order also on a printed form, both having conditions embodied which are at variance. There is no short answer to such a problem, but it can be said that unless it is expressed *in the writing* on the order that the estimate is accepted subject to certain of its conditions being replaced by others printed on the order, the conditions of the estimate will prevail and the order will be a good

acceptance on the terms of the estimate only. It is necessary, where applicable, to specify compliance with the I.E.E. "Regulations for the Electrical Equipment of Buildings" and with any Codes of Practice, for these are only effective if deemed to be embodied in the contract and expressed as being conditions. Compliance with statutory regulations, such as the Electricity (Factories Act) Special Regulations, 1908 and 1944, is to be implied in any contract to which they would be applicable; they cannot be expressly excluded, for that would introduce a taint of illegality sufficient to render the contract void from the start. Similarly, it is an implied term that completion of the contract is subject to the granting of any necessary licences.

The best guide to express terms for a contract of any size is either the full or the short form of the I.Mech.E. and I.E.E. General Conditions of Contract.* One or other of these may be embodied in the contract, or they may be used to assist in framing conditions suitable for special requirements.† Care must be taken in the latter case, however, to see that no contradictory clauses are included, for such clauses could easily cause difficulty in interpretation and possibly frustrate the whole object of the contract. If in doubt, it is wise to take competent legal advice.

* "Model Form of General Conditions of Contract A: Home Contracts, with Erection," and "Model Form A1S.F.: Home Contracts, with Erection (Short Form)," prepared by the Joint Committee of the two Institutions.

† The framing of suitable conditions is well treated in "The Conditions of Engineering Contracts," by E. J. Rimmer. (Journal Inst.C.E., 1939, Vol. 11, p. 3.)

STREET LIGHTING NOTES

A NEW mercury street lighting installation now extends from boundary to boundary of the borough of BERWICK-ON-TWEED along the A.1 highway, apart from the section of the Royal Tweed Bridge. It consists of 74 G.E.C. "Viatron" lanterns on Concrete Utilities columns. The lanterns house "Osram" 400 W mercury lamps. The improvement in lighting has been achieved without marring the ancient beauty of an historic town. The contractors who erected these columns on behalf of the G.E.C. were Watson, Norie & Co., Ltd.

The Ministry of Housing and Local Government has received applications by the Pelton and Lamesley Parish Councils for the provision of street lighting on housing schemes in the parishes. The Ministry has suggested that CHESTER-LE-STREET Rural District Council should consider the installation of lighting as part of the capital cost of the housing schemes, but the Rural Council has decided that street lighting should continue to be the responsibility of the local authority.

CARDIFF Corporation Public Works and Town Planning Committee recommends the installation of 205 lamps to provide Class "B" lighting for the roads on the Llanishen North housing site at an estimated cost of £7,750.

CHELTENHAM Streets and Highways Committee has considered estimates for the provision of lighting on the Arle and Hesters Way estates. Full Class "B" lighting with 85 45 W sodium lamps on 15ft columns, including cable work, for the stage II development would cost £5,043 and a skeleton scheme with 49 lamps £3,252. For stage III the respective figures would be £4,746 (83 lamps) and £2,962 (49 lamps). As it is not the practice of the Ministry at present to allow full schemes of Class "B" lighting, application is to be made for approval of the skeleton schemes, with cabling for the complete installations. Along the principal thoroughfare from Arle Road to the town centre Class "A" lighting with 35 140 W sodium lamps on 25ft columns is recommended, the estimated cost being £3,328.

SEAHAM Finance Committee is discussing with the North Eastern Electricity Board a £2,556 plan for improving street lighting.

Three schemes so far submitted to the Ministry of Transport for street lighting at CRIGGLESTONE, Yorks, have been rejected.

A parish meeting at SUTTON COURTENAY, Berks, has by an overwhelming majority passed a resolution for the installation of street lighting.

Because the electric lighting introduced along the Bradford–Huddersfield road, BRIGHOUSE, has had the effect of making adjacent streets and roads dark by comparison, the Borough Council sought approval for improved lighting in a number of other thoroughfares. The Ministry of Transport divisional road engineer has, however, indicated that the limit of total capital investment in street lighting has been reached up to which he can recommend authorization.

SURBITON Borough Council reports that the Minister of Transport is prepared to approve proposals for the provision of discharge lighting in Portsmouth Road and Surbiton Hill Road at a total cost of £2,150.

Commerce and Industry

Engineering Wages Claim

Investigations into Purchase Tax

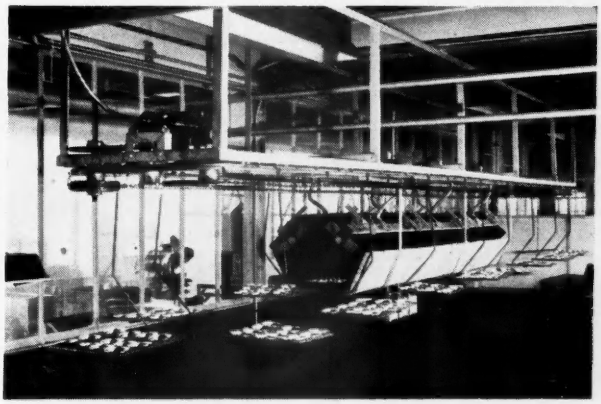
A MEETING of the Executive Council of the Confederation of Shipbuilding and Engineering Unions last week considered the rejection by the engineering employers of the unions' claim for an increase in wages of £2 a week. After the meeting it was announced that it had been decided to refer the matter to the Confederation's annual conference being held at Southsea this week.

At a meeting of Electrical Trades Union delegates at York last Friday it was decided that the union should press for strike action to enforce the £2 a week claim at the Southsea conference.

On Saturday last the National Committee of the A.E.U., meeting in London, decided to recommend the confederation to take a ballot on strike action or a ban on piecework and overtime to enforce the claim. The Confederation was also requested to ask the Trades Union Congress to convene a meeting of all affiliated unions to consider the policy of "freezing" wages and decide upon steps to counter it. A resolution calling for the claim to be referred to the Industrial Disputes Tribunal and another recommending union members to vote for strike action were defeated.

Stoving Synthetic Lacquer

An infra-red stoving installation designed and built by Casemakers, Ltd., for use in one of the factories of the Dennison group for drying synthetic lacquer on fabricated components has a loading of 22 kW and dries the components in four minutes at a rate of 500 an hour. There are six "Metrovick" infra-red projectors fitted with tubular sheathed elements which operate at red heat. These elements consist of a spiral of high grade heat resisting wire tightly embedded by a special process in a mineral insulator, enclosed solidly in a tight sheath of $\frac{5}{16}$ in tube of a non-scaling, non-corrodible alloy. The process ensures that the spiral is held immovable in the centre of the bores so that an even thickness of insulation separates it from the sheath. The trough reflectors are of aluminium sheet which has been subjected to a special anodizing process to give maximum heat reflection and to protect them from atmospheric corrosion. As will be seen from the illustration the construction of this particular plant is extremely simple; the projectors and conveyors are suspended from the ceiling leaving the entire floor area clear for the passage of trolleys, etc.



"Metrovick" infra-red projectors stoving synthetic lacquer on fabricated components

Capacitor Economies

For improving the power factor on its system, the Pacific Power and Light Co. has installed 142,000 kVAr of capacitors—60,000 kVAr (99 per cent switched) at main substations and 82,000 kVAr (17 per cent switched) on distribution circuits. The total is equivalent to 1 kVAr/kW of the system capacity of 345,000 kW. Last year the power factor is stated to have been 0·97 with losses of 235 million kWh, whereas without capacitors they would have been 0·82 with losses of 285 million kWh. At 0·25d/kWh the annual saving was thus over £50,000, which

is comparable with the annual charges on the capacitors, reckoned at 12½ per cent on £3/kVAr. Voltage drop in overhead lines was less by from 23 to 48 per cent and 15 per cent of kW capacity was released at no extra cost.

Zinc Price Reduced

The Ministry of Materials announces that from 8th August the price of good ordinary brand zinc is decreased from £130 to £118/ton delivered consumers' works. Premiums for higher grades remain unchanged.

Purchase Tax Investigations

The two committees appointed by the Chancellor of the Exchequer to study different aspects of purchase tax have held their first meetings. The first, under the chairmanship of Sir Maurice Hutton, is examining the position of traders holding goods on which purchase tax or customs and excise duty has been paid on an alteration of the rates of tax or duty. The committee is asked to consider whether there is a case for the payment of compensation for any loss occasioned and, if there is, to recommend methods of applying it. Representations should be addressed to the Secretary, Committee on Tax-Paid Stocks, Room 352, King's Beam House, Mark Lane, London, E.C.3. If possible twenty copies should be sent.

The other committee (chairman Mr. F. Grant, M.C., Q.C.) is to examine the representations of traders as to the principle of assessing purchase tax at a common value level; and to make recommendations as to the manner in which this or any alternative principle should be applied in valuation for purchase tax, having regard to the different points in distribution at which the tax has to be levied.

Representations, in writing in the first instance, from any person or organization interested in these matters (so far as possible through trade organizations) should be addressed, by 15th September, to the Secretary, Purchase Tax (Valuation) Committee, King's Beam House, Mark Lane, London, E.C.3, and wherever possible thirty copies should be sent.

Exports of Metal Goods

Open general export licences, operative from 11th August, have been issued by the Board of Trade in respect of certain metal goods. One of these covers copper cables and wires provided that the value exceeds the value of the copper or copper alloy content, calculated at the rate of £400 per ton. In the case of other copper goods the value must exceed the value of the copper or alloy content calculated at the rate of £500 per ton for copper and £420 for alloys mainly of copper. A similar arrangement for aluminium goods stipulates that the value should be calculated at £220 per ton.

Non-Ferrous Scrap Prices

The Minister of Supply (Mr. Duncan Sandys) has made an Order reducing the prices of secondary copper, brass, copper scrap, gilding metal scrap, brass scrap and cupro-nickel scrap to take account of the recent reduction in the Ministry of Materials selling price of virgin copper. The Order (the Copper, Zinc, etc., Prices (No. 4) Order, 1952, S.I. 1952 No. 1465) took effect on 7th August.

A New "Betro"

The registration is announced of British Export Trade Research Organization (1952), Ltd., among the founders being Mr. Leslie Gamage, who was chairman of the original "Betro," and Mr. Roger Falk, who was its director-general.

Cables for India

The accompanying picture shows a consignment of "Ediswan" cable coming forward for loading on to the s.s. *Clan Maclean* at Birkenhead Docks recently. It is part of a shipment of 11,220 yd (51 drums) of 37 0·116in 3-core paper insulated, lead alloy sheathed, steel tape armoured and served, 5,000 V underground power cable for use in the new underground power distribution scheme at Bangalore, India.

Consignment of "Ediswan" cable at Birkenhead Docks awaiting shipment to Bangalore

A.S.E.E. Awards

The Inventions Committee of the Association of Supervising Electrical Engineers, in collaboration with Dr. A. P. Thurston, has awarded the silver trophy and prize of £10 to Mr. J. Flood, Associate I.E.E., Chiswick, for his invention of the Enfield grid suspension wiring system, in the A.S.E.E. Inventions Competition for 1951–52. The presentation will be made at the opening meeting of the London lecture session on 21st October at the Lighting Service Bureau, London, W.C.2. Other entries which received special commendation were a wedge type self-tightening grip for overhead line wire straining tools and an automatically switched battery operated illuminated direction indicator for motorists and cyclists, both submitted by Mr. G. A. Leighton, Morpeth, Northumberland, and a multiple pneumatically operated switch for dielectric heating processes submitted by Mr. J. Myers, Osterley, Middlesex.

The Executive Council of the Association announces the award of the W. E. Highfield Shield and the first prize of ten guineas to Mr. D. H. Taylor, Graduate I.E.E., New Barking, Essex, for a paper on "The Metadyne"; the second prize of five guineas has been awarded to Mr. C. A. Jones, Catford, London, S.E., for a paper on "Cold Cathode Lighting in the Modern Interior." The prizes will be presented by Mr. T. G. N. Haldane at the opening meeting of the London lecture session.

I.C. Engine Production

Continuing its series of reports on improved productivity in various industries the Anglo-American Council on Productivity has published a survey of the internal combustion engine industry based on the study of the activities of fifteen companies in this field. After commenting on the tremendous expansion of the industry in the past few years the report goes on to deal with methods adopted to simplify and speed-up production. They include the reduction of the number of types made, reorganization of assembly methods, the greater use of mechanical handling systems, work study, incentives, planning and control, and training schools.

Fatality

While fastening a load to a mobile crane during the course of work on the Fannich (Rossshire) hydro-electric scheme Neil Macleod was killed when the jib chain came into contact with an overhead power line.

Credit for Pretoria

The Pretoria, South Africa, correspondent of *The Times* reports that representatives of the City Council recently visited Great Britain to consult leading firms with whom the Council had contracted for the supply of equipment. It was pointed out that shortage of capital threatened to hold up an electrical development scheme costing £5 million. Agreement was reached for the supply of £1½ million worth of equipment, including a turbo-alternator, and guarantees were given to the deputation that credit facilities would be available for the equipment needed for three further stages of construction to be completed by 1960.

Prices of Materials

In the accompanying table we give the prices of the more important materials used in the electrical industry. The figures are those quoted on Monday last.

ALUMINIUM Ingots	ton £157 0s 0d
COPPER, H.C. Electro	ton £285 0s 0d
Fire Refined 99·70 per cent ..	ton £282 0s 0d
Fire Refined 99·50 per cent ..	ton £274 0s 0d
COPPER Tubes	lb 2s 8¾d
Sheet	ton £339 0s 0d
H.C. wire and strip	ton £317 15s 0d
LEAD, English	ton £132 10s 0d
Foreign	ton £131 0s 0d
MERCURY	flask £65 10s 0d
TIN	ton £932 10s 0d
ZINC, G.O.B. Foreign	ton £130 0s 0d
Electrolytic	ton £134 0s 0d
BRASS Tubes	lb 2s 3¼d
Sheet	lb 2s 6¾d
Wire	lb 2s 9¾d
PHOSPHOR BRONZE	
Wire	lb 4s 1¼d
RUBBER, No. 1 R.S.S. spot ..	lb 26½–26¾d

South East London Technical College

Details of postgraduate courses on a wide variety of subjects are given in the 1952–53 prospectus now available from the South East London Technical College, Lewisham Way, London, S.E.4.

New Paper Mill Installation

Extensions and alterations estimated to cost in the region of £70,000 are nearing completion at the works of Caldwell's Paper Mill Co., Ltd., Inverkeithing. The developments include the installation in the power house of a new 5,000 kW turbo-generator to be used as stand-by for the existing set, and the installation of a ring main in place of the existing l.v. distribution system.

German Electrical Directory

We have received from the publishers, Elektro-Verlag w. Sachon K.G., Schloss Mindelburg, Mindelheim, Germany, a copy of their directory "Die Deutsche Elektro-Industrie," which appears to be a very comprehensive guide to the firms comprising the West German electrical industry and their products. Four languages are employed—German, English, French and Spanish and the directory is in eight principal sections covering the organization of the industry (in German only) and its association (Zentralverband der Elektrotechnischen Industrie); goods classification (on the decimal

system); goods index, showing the manufacturers of each class; index of firms, giving addresses and brief indications of their products; goods index in tabulated form; trade names and marks index; the English, French and Spanish equivalents of German terms; and an index of reference terms with indications of the production groups containing the products listed.

The directory has nearly a thousand pages measuring 8¼in by 11¾in and costs 65 DM.

Cable Plant for Jugoslavia

A contract was signed in Belgrade last week by Mr. M. I. Lipman of the British American & Eastern Co., Ltd., London, on behalf of the General Engineering Co. (Radcliffe), Ltd., for the supply of a complete paper cable treatment and impregnating plant for a large new cable works now being built in Serbia. The contract was secured in the face of keen German competition.

This is the second important contract obtained in Jugoslavia for the General Engineering Co. (Radcliffe), Ltd., within the last few months, the earlier contract being in respect of a large plant for the treatment of oil filled transformers for use at a large electrical works now being extended for this class of work.

The two contracts have a value of about £250,000.

Indian Telephone Cable Factory

It is reported by the *Indian Electrical Contractor and Trader* (Bombay) that to meet the Indian demand for telephone cables, amounting to about Rs 80 lakhs (£600,000) a year a factory is to be erected at Mihijam, West Bengal, by Standard Telephones & Cables, Ltd. (England) by agreement with the Government. The cost is said to be Rs 1 crore (£750,000).

Purchasing Officers' Conference

The Purchasing Officers' Association is holding its 1952 National Conference and "Minibition" at the Royal Hall, Harrogate, from 2nd to 5th October. Four hundred delegates from all over the country will be attending, and 100 firms will be exhibiting in the Minibition, which is being held in the annexe and promenades of the Royal Hall. The conference, which marks the 21st anniversary of the Association, will be declared open by Lieut.-Comdr. J. Gurney Braithwaite, M.P., Parliamentary Secretary to the Ministry of Transport and Civil Aviation.

During the course of the conference there will be a discussion between Mr. C. Hughes, past chairman of the Electric Lamp Manufacturers' Association, and Messrs. A. Elliott (Churchill Machine Tool Co., Ltd.) and W. H. Napper (South Eastern Gas Board) of the P.O.A., on "The Effect of Price Rings Upon Industry." Members of the Anglo-American Productivity Council's Production Control team will be discussing their recent visit to the U.S.A. Among other speakers will be the Earl of Verulam. The principal guests at a dinner-dance will be Lord McGowan and Sir Harry M. Garner, C.B.

Trade Announcements

The depot for the Newport Cables Division of **Standard Telephones & Cables, Ltd.**, which handles the company's rubber, plastic and textile insulating cables and strip wiring cables, has recently moved to new premises at 21, Queen Street, Newcastle (telephone : Newcastle 20290).

Max Arc & Electrics, Ltd., have moved to Terrace Road, Walton-on-Thames (telephone : Walton-on-Thames 2497-8).

Mr. A. Lloyd Thomas, who has represented **Chilton Electric Products, Ltd.**, in the North, has been transferred to London where he will deal with the electric dry shaver business only. Mr. W. E. Garratt, formerly of Ekco Ensign, Ltd., will represent the company in Lancashire and Yorkshire for the sale of dry shavers and circuit breakers.

Catalogues and Lists

Alliance Wholesale, Ltd., 24-30, Gillingham Street, London, S.W.1.—Second edition of catalogue 492 dealing with conduit and conduit fittings (originally issued June, 1949).

New Era Industries (Tottenham), Ltd., Stoneleigh Road, Tottenham, London, N.17.—Illustrated priced catalogue dealing with "New Era" fluorescent lighting fittings and associated control gear.

Thorn Electrical Industries, Ltd., 105-109, Judd Street, London, W.C.1.—Handbook of "Atlas" lighting fittings for tungsten filament lamps (AL/114) and a 40-page catalogue of tungsten and fluorescent "Atlas" lamps and price list (AL/90A).

Ekco-Ensign Electric, Ltd., 45, Essex Street, Strand, London, W.C.2.—Illustrated priced catalogue of industrial lighting equipment including bulkhead fittings, well-glass lanterns, floodlight projectors, etc. (TFC/52).

Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, Watford By-Pass, Watford, Herts.—Illustrated technical folder on horizontal "Hairpin" furnaces (HH 252).

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—132-page illustrated catalogue containing a comprehensive range of flameproof and safety equipment (1492).

Electric Elements (Willenhall), Ltd., Wolverhampton Street, Willenhall, Staffs.—Priced pamphlet setting out their range of "Series E" vitreous enamelled resistor (V 101).

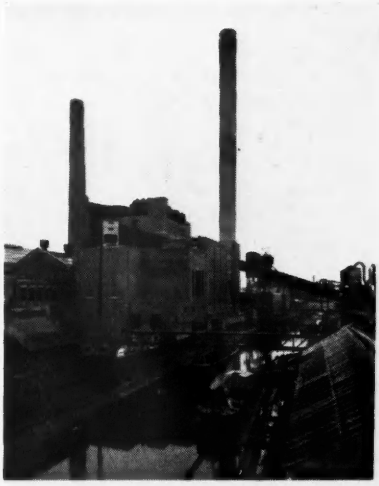
First B.E.A. Gas Turbine

Put on Load Last Week

THE 15,000 kW gas-turbine set was put on load for the first time on 6th August at Trafford power station, Manchester. It operates on an open compound cycle and consists of a low-pressure compressor, an air intercooler, a high-pressure compressor, a heat exchanger, a main combustion chamber, a high-pressure turbine, a reheat combustion chamber, and a low-pressure turbine. The air flows through these components in the order named, and the exhaust from the last item passes back through the heat exchanger (which is analogous to an economizer in a steam plant) before its discharge to a reinforced concrete stack, 250ft high.

The low-pressure turbine is directly coupled to the low-pressure compressor and to the 15,000 kW alternator; it runs at 3,000 r.p.m. under the control of a governor operating on the fuel admission to both combustion chambers. The high-pressure turbine is coupled to the high-pressure compressor and runs at a speed determined by the load conditions (5,500 r.p.m. at full load).

The plant is started by a 400 h.p. a.c. motor coupled to the high-pressure units, the motor being automatically declutched on reaching a speed of about 3,000 r.p.m.



The Trafford station at which the new 15,000 kW gas-turbine set is installed

Gas oil is now the operating fuel, but later it is hoped to modify the plant to use heavier grade oils. Before admission to the low-pressure compressor, the incoming air is passed through an electrostatic filter, which removes solid impurities that would otherwise impair the efficiency of the compressor blading. To withstand the temperature of the gases entering the turbines, about 1,200 deg F, which is considerably higher than that of superheated steam, alloys are used for the blading, consisting mainly of nickel and chromium with only minute quantities of iron.

The gas turbine can be started up

Mr. A. R. Cooper (*on the right*) **with members of the Trafford station staff**

quickly and occupies less space and involves less material in manufacturing than a corresponding steam set but its thermal efficiency is comparable. The Trafford set was built by the Metropolitan-Vickers Electrical Co., Ltd., whose claims to priority also include the first application of the gas turbine to marine propulsion and the building of the first British gas-turbine locomotive.

On the day the set was put on load the Controller of the North Western Division of the B.E.A., Mr. A. R. Cooper, was asked by the B.B.C. to give a short talk in "News from the North" upon the significance of the gas turbine to the electricity supply industry.

We reproduce a picture of Mr. Cooper and some of the staff of the Trafford station taken on 6th August.

The Sale of Electricity

Signs of a Declining Trend

STATISTICS prepared by the British Electricity Authority show that in each month from March to June this year inclusive there was a decrease in the sale of electricity as compared with the corresponding months of last year. An indication of this has been given by the Ministry of Fuel and Power's monthly returns (the latest figures—those for June—were published in our issue of 25th July).

The table reproduced with these notes sets out the sales of electricity by the fourteen Area Boards. Seven of the Areas are termed "industrial" because more than half of their sales was to industrial consumers. This is somewhat arbitrary; in the case of South West Scotland, for instance, the proportion of industrial sales was a little below half in 1949–50 and a little above in 1950–51.

The large increases shown in the cases of the Southern and South Wales Areas seem to be explained respectively by the demands of the Fawley oil refinery and the new Margam works of the Steel Company of Wales. Apart from South Wales, the "industrial" Areas are seen to have suffered a decline in sales in June and in the first three months of the current financial year. Only three Boards had larger sales in this first quarter and their total was 2·9 per cent below that of April–June, 1951.

An attempt has been made by the B.E.A. to adjust the figures to normal weather and standard working days. This gives the following increases in sales as compared with the corresponding periods:—June, 1·4 per cent: April–June quarter, 2·7 per cent; twelve months to end of June, 4·8 per cent.

ELECTRICITY SENT OUT BY AREA BOARDS TO CONSUMERS

Area Board	Totals for June			Cumulative totals for three months, April–June			Totals for 12 months ended 30th June		
	1951 Mill. kWh	1952 Mill. kWh	Inc. or Dec. %	1951 Mill. kWh	1952 Mill. kWh	Inc. or Dec. %	1951 Mill. kWh	1952 Mill. kWh	Inc. or Dec. %
London	323	325	+ 0·6	1,187	1,098	− 7·5	5,241	5,210	− 0·6
S. Eastern	187	191	+ 2·1	671	645	− 3·9	2,885	2,991	+ 3·7
Southern	217	236	+ 8·8	759	768	+ 1·2	3,261	3,458	+ 6·0
S. Western	109	113	+ 3·7	386	374	− 3·1	1,657	1,676	+ 1·1
Eastern	316	329	+ 4·1	1,118	1,085	− 3·0	4,734	4,864	+ 2·7
E. Midlands*	297	291	− 2·0	986	946	− 4·1	4,107	4,200	+ 2·3
Midlands*	401	400	− 0·2	1,340	1,315	− 1·8	5,587	5,751	+ 2·9
South Wales*	241	254	+ 5·4	738	789	+ 6·9	2,912	3,190	+ 9·5
Mersey & N. Wales*	247	236	− 4·5	811	762	− 6·0	3,436	3,420	− 0·5
Yorkshire*	400	393	− 1·7	1,292	1,277	− 1·2	5,373	5,531	+ 2·9
N. Eastern*	257	244	− 5·1	830	791	− 4·7	3,410	3,503	+ 2·7
N. Western*	456	422	− 7·5	1,477	1,399	− 5·3	6,069	6,402	+ 5·5
S.E. Scotland	79	82	+ 3·8	265	266	+ 0·5	1,147	1,191	+ 3·8
S.W. Scotland	194	198	+ 2·1	658	640	− 2·7	2,836	2,880	+ 1·6
Total all Area Boards	3,724	3,714	− 0·3	12,518	12,155	− 2·9	52,655	54,267	+ 3·1
Direct Sales by B.E.A.	56	55	− 1·8	169	171	+ 1·2	705	712	+ 1·0
Grand Total	3,780	3,769	− 0·3	12,687	12,326	− 2·8	53,360	54,979	+ 3·0
Mainly Industrial Areas*	2,299	2,240	− 2·6	7,474	7,279	− 2·6	30,894	31,997	+ 3·6
Mainly Non-Industrial Areas	1,425	1,474	+ 3·4	5,044	4,876	− 3·3	21,761	22,270	+ 2·3

* Over half the sale of electricity by these Boards is to industrial consumers

Switch and Fuse Gear

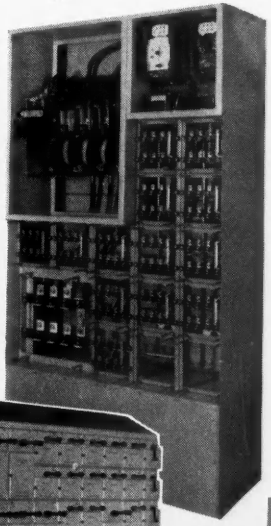
Ready Adaptation to Meet Special Requirements

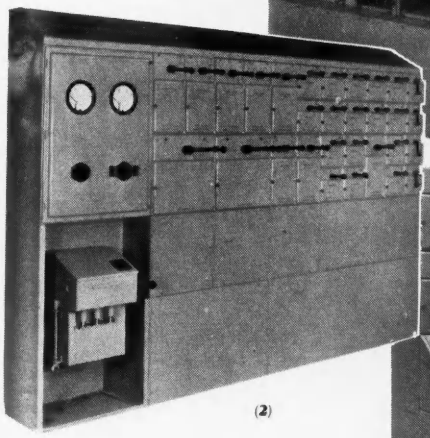
THOUGH established only six years ago, Varilectric, Ltd., has already supplied switch and fuse gear for a large number of important installations at home and abroad, including the Government's new buildings at Whitehall Gardens, the British Embassy in Paris, the Austrian Embassy, the Old Bailey, St. Thomas's Hospital, and the White City greyhound track.

This rapid incursion into what one might have thought to be an already well served section of the electrical market is traceable to the development of basic designs which have been reduced to their simplest terms and which readily permit adaptation to meet customers' special requirements. The result is exceptionally rapid delivery—often from stock but in any case in a matter of days rather than weeks or months.

The design of the switch and fuse gear is particularly noteworthy. Breaking away from convention, the operating handle is in the front rather than at the side and an especially important point is that it is impossible to operate the switch slowly, thus giving a high breaking speed. As throughout the design, the contacts are very simple, consisting of two pieces of hard drawn copper giving a ring and line contact with the arcing occurring on the back. The design of the switch with separate front and back portions is a feature much liked by electrical contractors who appreciate the ability to remove the whole of the front assembly. A novel

(1)





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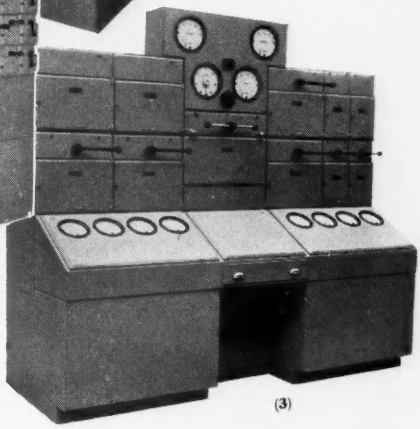


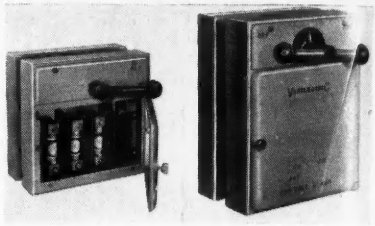
(3)

(1) One of several switchboards made for R.A.F. canteens. (2) Switchboard installed at the Old Bailey. (3) Sub power board for White City greyhound racing track

mechanical safety device prevents the removal of plugs when the switch is in the " on " position.

The versatility of the equipment is demonstrated by the readiness with which the switch and fuse gear and distribution boards can be built up into composite units. Compactness is another striking feature, a 500 A t.p. and n. fused switch, for example, being housed in a case only 18in by 18in. An interesting variation of a normal switch fuse unit is a fused change-over switch, the moving mechanism carrying the fuses. The company, by the way, claims to be the only manufacturer in the country, if not the world, producing a unit of this kind.

Now employing over 150, the company is practically self-supporting. It has no facilities for casting but it undertakes all its own press work and makes its own tools. Development work and the production of special equipment is carried out at the main factory in Melon Road, Peckham, which incidentally was once the site of Thomas Tilling's original horse bus stables.



A 500 V 60 A t.p. and n. fused switch and (right) 500 V 30 A single pole change-over fused switch

Quantity production of standard components and units is handled at a subsidiary factory at Stony Stratford. Here much of the sheet metal work is dealt with including the manufacture of components for the company's overhead busbar system, which comprises 7in by 3in trunking to provide for a 300 A 4-wire distribution. Plans in hand for the expansion of the manufacturing facilities aim at providing four times the floor area available for production by the end of the year.

Training Latin-American Engineers

British Mission's Tour

THE British Engineering Training Mission to Latin-America, consisting of Sir Arthur Fleming, C.B.E. (chairman of the F.B.I. Overseas Scholarships Committee), Mr. F. R. Livock (member of the F.B.I. Overseas Scholarships Committee), and Mr. W. V. Jenkins who administers the F.B.I. Overseas Scholarships Scheme, has now returned to this country. It left England on 29th April and visited Colombia, Venezuela, Cuba, Mexico, Peru, Chile, Argentina, Uruguay and Brazil, travelling over 20,000 miles and spending one week in each country and two weeks in Brazil.

The main purposes were to investigate the technical training arrangements for young engineering graduates in these countries with a view to providing a selected number of them with scholarships for practical training in Britain and, secondly, to make known to all concerned, including government departments, industrialists and universities, the exceptional practical training facilities which Britain can offer.

A full report of the findings of the Mission will be published in the near future. Meanwhile, it may be said that the scholarships to be offered to Latin-American countries are an extension of the general F.B.I. Overseas Scholarships Scheme which was established two years ago as part of a long-term export trade policy as well as to assist overseas countries in process of economic development.

Sir Arthur Fleming said that the Mission was greatly impressed by the potentialities of these Latin-American republics and their importance from the point of view of future British export trade. Their economic progress depended very largely on the work of the engineer to provide facilities for transportation, communication, power supply and for the general development of the natural resources of the various countries. There was thus a great need for fully trained engineers.

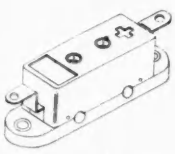
The offer of practical training in Britain for young engineers was received with the greatest interest and enthusiasm and the Mission succeeded in reviving interest in Britain generally. Sir Arthur emphasized that British industry must seize this advantage and, by training young Latin-American engineers in increasing numbers, turn to practical account the priceless assets of traditional skill in craftsmanship, organization and invention which Britain possessed.

RECENT INTRODUCTIONS

Notes on New Electrical and Allied Products

Facilitating Current Measurement

A SPECIAL type of jack unit has been designed by PHILLIPS & BONSON, LTD., Imperial House, Dominion Street, Moorgate, London, E.C.2, to facilitate the measurement of current flowing in a circuit. The "Amp-Check" is a small moulded device about 2in long and by its use it is claimed that an ammeter can be connected into a circuit without interruption of current flow. All that is required is a pair of probes, connected to the terminals of an ammeter; they are inserted in the two holes of the "Amp-Check" which is permanently in circuit and the current is read directly on the ammeter. Internally there are two standard silver contacts with a silvered spring strip between them. Insertion of the ammeter probes makes connection with the circuit before the contacts open and withdrawal of the probes disconnects the meter only when the contacts have again closed. Although what is effectively a switching process takes place the design is said to be such that there can be no arcing and the current flow is continuous.



"Amp-Check" current measuring unit

Portable Spot Welder

An inexpensive, portable spot welder suitable for use in the garage and small workshop is being manufactured by RING MOTORS, LTD., of Ayres Road, Old Trafford, Manchester, 16. The "Leopard" spot welding unit is available for 200/240, 340/380, 400/440 or 440/480 V, 50 or 60 c/s. The power factor is about 0·75 lagging. The weight, without cable, is just over 25 lb and the consumption of electricity is approximately 1 kWh/hr, during which time it is claimed 500 spots could be made. Complete with tongs, one pair of standard tips and 25ft of input cable, the price is £45.

Bell Transformers

MORPHY-RICHARDS, LTD., 121, Victoria Street, London, S.W.1, announce the production of a transformer to replace models MR/3 and MR/4 which are now withdrawn. The new transformer, model MR/5, is made in three ranges for use on 100/120 V, 200/220 V and 225/250 V. It can be used for the energizing of any make of electric bell or chime requiring 4, 8 or 12 V and the current rating is 1·75 A. The price, which is lower than those of the models that it supersedes, is 18s 6d.

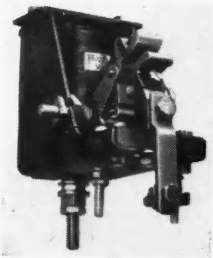
Davit Control Panel

A two-speed, non-reversing, automatic d.c. control panel introduced by DE RENZI HOLMES & Co., LTD., Fox's Lane, Wolverhampton, has been specifically developed to conform with Lloyd's Regulations for the hoist motions of boat davits where lowering is effected by means of gravity.

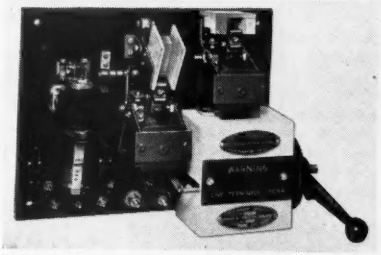
Of robust construction, necessary for marine use, the panel is fitted with an electrically interlocked d.p. isolating switch and a s.p. line contactor with magnetic blowouts. The s.p. overload relay has oil dashpot timelag and the trip switch is fitted with self-wiping action silver contacts.

Operation is by push-button and the circuit is so arranged that the accelerating contactor is de-energized as long as the starting button is held down, and only closed when this is released; by this means a low speed is obtained at the operator's choice.

This s.p. accelerating contactor, designed for 80 A and a maximum of 600 V d.c., consists of heavy steel pressings, sherardized to prevent rust. The



"Deren" type D.80 contactor and (below) the boat davit control panel



contact tips are easily accessible for renewal and a special feature is the arrangement whereby the whole of the moving parts, including flexible connections, can be removed from the front of the frame without disturbing the contactor mounting or fixed connections. The contactors in addition to their use in boat davit and winch control panels are also extensively used in the control system for battery operated electric vehicles.

Switched Socket Outlets

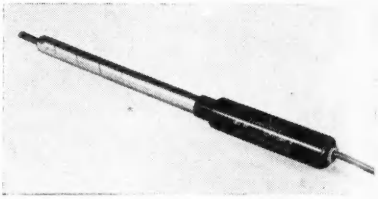
Following the introduction of Lundberg 13 A switch socket outlets, the SIMPLEX ELECTRIC CO., LTD., Broadwell, Oldbury, Birmingham, now announces a new range of 5 A a.c. switch sockets. They are designed for both surface and flush mounting and incorporate a double pole a.c. switch with heavy silver contacts and shuttered sockets.

Lundberg 5 A flush pattern switch socket

The surface pattern measures 2in by 2in by $1\frac{5}{16}$in and includes four knockouts; the dimensions of the flush pattern are $3\frac{1}{4}$in by $3\frac{1}{4}$in. The latter fits a B.S. 1299 box.

Small Soldering Iron

A soldering iron which is only 11in long has just been placed on the market by KENROY, LTD., 152, Upper Street, London, N.1. With a



"Tyana" electric soldering iron

rating of 40 W, it weighs only 4 oz and is available for operation on 100/110, 200/220 and 230/250 V.

The "Tyana" soldering iron is fitted with an adjustable bit which heats to the required soldering temperature within three minutes. Especially suitable for radio and instrument mechanics, the tool retails at 16s 9d.

Portable Panel Radiator

The electrically-operated panel type radiator made by HURSEAL, LTD., 229, Regent Street, London, W.1, is now available with feet for portability and greater convenience.

Australian Electrical News

From Our Correspondent

THE Tasmanian Hydro-Electric Commission has cancelled many orders for electrical equipment because of the shortage of loan funds, and it is officially stated that the future of its power development schemes will be governed largely by the success of further loans to be sought (the Commission's 1952–53 loan allocation will be £8 million instead of the £14 million needed). Permission has been given for the raising of £3 million on the open market, but even if this amount is obtained, there will be a shortage of £3 million. A large proportion of the £8 million loan will be absorbed by the purchase of turbines, piping and hydraulic valves and associated equipment.

In the recent "Canberra Letter" of the Associated Chambers of Manufactures a specific example of the way in which high costs are forcing Australian manufacturers out of their own market is given. The Federal Director (Mr. Latham Withall) says that in a period of four weeks contracts for British electrical switchgear, totalling £161,014, have been let by the Brisbane City Council, the Newcastle City Council and the Sydney County Council.

The contracts are for equipment which is manufactured in Australia, but the lowest tender from Australian manufacturers was nearly half as high again as the British price. The price difference was in no way due to inefficiency of the local manufacturer or the profit margin sought (the latter being abnormally low due to the fierce competition being encountered) but is solely due to the fact that, expressed in Australian currency, the hourly wage rate paid to skilled employees of the Australian electrical industry is 7s 4·9d compared with 3s 11·4d in the United Kingdom. Consequently when the Sydney County Council placed one-third of its contract with local manufacturers, it did so only because of the importance of the industry for defence purposes and the desirability of maintaining an alternative source of supply.

ELECTRICITY SUPPLY

Coronation Floodlighting

Street Lighting in Liverpool

MAIN emphasis for decorating Bristol during the Coronation festivities will be on floodlighting. This has been agreed in principle by the Public Works Committee and such decorations will follow generally those of the Festival of Britain, but full details cannot be made available until it is known how long the festivities will last. They are certain to include lighting the suspension bridge, and floodlighting Brandon Hill and Tower, and Queen Square.

Alternative South Wales Site

The Monmouthshire Federation of Trades Councils has suggested an alternative 50-acre site at Winchestown, near Brynmawr, for the construction of the new generating station that the British Electricity Authority proposes to build at Rhiwderin. There is considerable opposition to the use of the latter site, which is stated to be good agricultural land.

Cooling Tower Modifications

The British Electricity Authority has commenced work on alterations to the cooling towers at Sunderland power station to prevent spray falling on to surrounding property. Recently the Town Council complained against the delay in commencing remedial measures. To deal with the nuisance an eliminator, similar in design to a venetian blind, is being built. It is 128ft wide and while it will allow vapour to escape it will hold back droplets of water.

Liverpool Lighting Report

The report for 1951–52 of the Liverpool city lighting engineer (Mr. C. C. Smith, A.M.I.E.E.) shows that at the end of the period a street mileage of 451 was electrically lighted while 393 miles were lit by gas—a total of 844 miles. The pre-war figures were: electricity 386 miles, gas 567 miles; total 953 miles. There were 20,496 electric lamps and 10,656 gas lamps. An additional 97 sodium lamps were installed in two miles of streets raising the total to 3,262 lamps in 61 miles of streets.

There was a reduction from 8·0 million kWh to 7·4 million in electricity consumption, reducing the bill from £35,784 to £33,689. There was also a smaller gas consumption (499,161 therms, against 536,185 therms), but the cost rose from £16,979 to £19,510.

The report mentions the other work carried out by the department—the maintenance of electrical installations and gas apparatus in Corporation buildings and the maintenance of the electrical and mechanical equipment in the Mersey Tunnel.

Centralized Control in Auckland

It is reported that the Auckland Electric Power Board, New Zealand, has placed a contract amounting to £29,342 with the Automatic Telephone & Electric Co. for control equipment for street lighting. In addition, states *Tenders* (Australia) the Board is expected to place a contract with the same company for a water heating control system. This, however, depends upon the effect on the financial advantages of the scheme of the tariff changes contemplated by the State Hydro-Electric Department. The object is to reduce the peak loads and thereby lower the Board's m.d. charge. It is estimated that on the present basis there would be a net saving up to 1958 of £55,369 a year and in the following five-year period £34,370 annually. The total cost of the scheme up to 1963 would be £822,590.

Overhead Line Route

A correspondent of the *Manchester Guardian* states that some of the landowners concerned as well as organizations interested in the protection of the countryside have expressed anxiety regarding the effect of the proposed 275 kV overhead line between Carrington power station and Burton-on-Trent. Part of the route passes through the parks of Dunham Massey (near Altrincham), Alderley and Capesthorne, and close to the village of Gawsworth. The East Cheshire Branch of the Council for the Preservation of Rural England has objected strongly to the route and has suggested its diversion westwards.

Malayan Extension Inaugurated

On 17th July Mrs. Oscar Spencer, wife of the chairman of the Central Electricity Board, Federation of Malaya, switched on an electricity supply at Kuala Selangor. This, the eighth supply scheme to be completed since the liberation of the country, has cost $M250,000 (nearly £30,000), including staff quarters, and it will be some years before it becomes financially

self-supporting. The present plant consists of a 75 kW oil engine driven set. A 22 kW set is to be installed later this year and another of the same capacity early next year. Until these smaller sets are available only a 12-hour supply will be given. Speaking at the opening ceremony, Mr. F. P. Egerton, general manager of the C.E.B., surveyed the Board's plans. He said that the first half of the 80,000 kW Connaught Bridge power station at Klang, commenced in 1947, should be in operation by the end of the year. The station would give bulk supplies of electricity to Selangor, Negri Sembilan and Malacca and would enable all restrictions to be lifted. Extensions to generating plant were in progress at 25 of the Board's stations at a cost of $M3,500,000 (£408,700).

No Electric Cooking Facilities

After considering a request from the East Midlands Electricity Board, Warwick Corporation has decided not to install circuits for electric cookers in municipal houses at the expense of the Corporation.

Large Overhead Line Cable

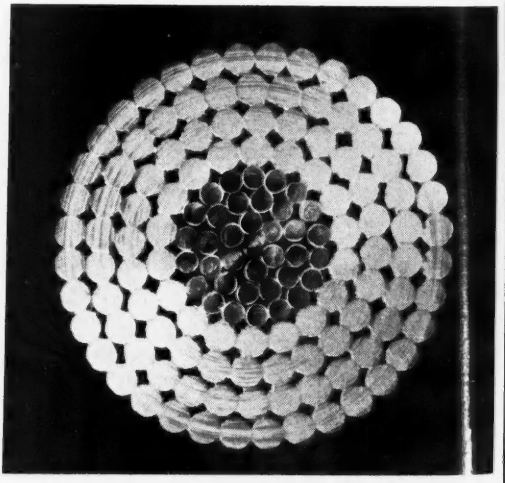
Stranded Conductor for Power Transmission

THE accompanying actual size illustration is of a section of what is claimed to be the largest stranded conductor ever to be fabricated for an overhead power transmission line. It is 2·295in diameter and consists of 108 aluminium wires stranded over a core of steel wires. The cable is required for a development project of the Aluminium Co. of Canada and will convey power over a particularly mountainous 10-mile pass section of the 50-mile long transmission line between the power house at Kemano and the aluminium smelter at Kitimat. The cable will have an ultimate tensile strength of 135,700 lb and has to provide absolutely reliable service as the smelting process is a continuous one while that portion of the line within the pass will be subject to heavy icing conditions and a high wind load. By fabricating a.c.s.r. (aluminium cable steel reinforced) of this dimension Canadian engineers have solved a most difficult problem.

Basic conditions determining load combinations for the towers have been taken as follows: (*a*) Ice load of 40 lb/ft of conductor length at zero deg F, as a yield point load; (*b*) 2·5in radial ice deposit on the conductor; (*c*) 2·0in radial deposit of rime on the conductor combined with wind of 8 lb/sq ft; (*d*) ¾in radial deposit of ice combined with broken conductor action.

The (*a*) loading is used for determination of the yield point stresses whereas the others are used for computation of stresses under normal working loads. The specific gravity of ice is taken at 0·90 and of rime at 0·30, in the specified cases. The wind pressure on flat tower members, considering the members to be coated with 1in ice, is taken at 1·6 times the wind pressure on the conductor.

The loads at conductor support points resulting from the above conditions, plus the dead load of the conductor and the hardware, together with the extreme limits of tower application as to line angle, span and slope, are being used as the basis for tower design. For the single-circuit tower lines through the Kildala Pass, the conductor will be a.c.s.r. with an outside diameter of 2·295in, a weight of 4·77 lb/ft and it is designed to have an ultimate strength of 135,700 lb, the cross-sectional area being 3,364,000 circular mils.



Cross section of the large Canadian power line conductor (actual size)

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

Oldham & Son, Ltd., record a net profit of the group for the year ended 31st March, before charging taxation, amounting to £319,706, compared with £270,176 in the previous year. Taxation requires £187,362 (£157,007), leaving a balance of £132,344 (£113,169). It is proposed to transfer £100,000 (£65,000) to general reserve bringing it up to £350,000 and to increase the final dividend from 15 to 20 per cent, making 35 per cent (30 per cent) for the year, and to carry forward £92.116 (£104,414).

In a statement accompanying the report and accounts, Mr. John Oldham (chairman) points out that the profit for the year is a record one, achieved by an increased volume of sales in all departments and by the installation of new processes and methods of production which have offset substantial rises in costs. The variety as well as the volume of production has increased substantially. The new tool and engineering department was completed early in the period under review. The company's research programme has been expanding during the past five years, the new " Fibrak " battery separator providing practical evidence of the value of long-term research. Large-scale production of this separator under licence, amounting to several millions a week, is now under way in the United States. Large-scale production has also commenced in the company's own works and adequate quantities should be available to meet requirements this year. Direct exports have increased despite the operations of their overseas companies. Oldham & Son (Africa), Ltd., in which the company holds a 50 per cent interest, has made further progress, and production of batteries by Oldham & Son (India), Ltd., commenced to get under way at the Madras plant during the year.

Kelvin & Hughes, Ltd.—In his speech at the annual meeting last week the chairman (Mr. Ralph Gordon-Smith) said that so far as the retention of profits was concerned recognition had been given to the increase in working capital resulting from changes in the purchasing power of money by transferring to capital reserves £50,000 out of the year's profits and £200,000 out of past accumulations. In the past year output went up by nearly 50 per cent on the previous year's total and all their commercial divisions—marine, aviation and industrial—contributed to this increase. Over half of the company's commercial output was exported in the face of increasing foreign competition. They had improved considerably on delivery dates, and efforts were being made to reduce them still further in spite of material shortages. Orders received during the year again showed a substantial increase over the previous year.

During the year, the company had re-acquired control of Kelvin, Bottomley & Baird (Canada), Ltd., whose name had been changed to Kelvin & Hughes (Canada), Ltd. Price was once again rapidly becoming a vital factor in getting orders from other countries and it was with the utmost reluctance that they had been compelled to increase their prices during the year due to wage increases. Competition was now being met from Germany and the Japanese were also showing signs of entering the instrument field. High prices would definitely mean less business, with serious consequences for the country.

With the net profit increasing from £91,523 to £184,948 it is proposed to raise the dividend from 7½ to 12½ per cent for the year ended 29th March.

Electrical Components, Ltd.—Despite a decline in turnover during the late summer of 1951 the combined group profits for the year ended 31st March have been maintained, working out at £141,372, against £140,376 for 1950-51. Taxation absorbs £90,987 (£86,665). It is proposed to pay a final dividend of 12½ per cent, again making 20 per cent for the year, and £46,945 (£41,165) is carried forward. In his review the chairman, Mr. L. S. Seccombe, mentions that it has been possible to secure occupation of the whole of the leasehold premises in Ludgate Hill, Birmingham, which will enable the group headquarters, Birmingham trading branch and general showrooms all to be located under one roof. The directors have also entered into arrangements to acquire control of a small distributing company in Scotland.

Calcutta Tramways Co., Ltd., report that, subject to audit, the accounts for 1951 show a balance of £87,457 credited to shareholders' account, compared with a profit of £60,811 for 1950. This result was reached after charging £150,000 (£122,000) for tax, £80,000 (same) for renewals and replacements,

£3,018 (nil) for deferred repairs, £74,354 (nil) for special reserve, nil (£60,000) for improvements and extensions, and £25,939 (£26,223) debenture interest. A final dividend of 3½ per cent tax free again makes 6 per cent for the year. The accounts have been drawn up on the basis of the agreement dated 30th August, 1951, between the Governor of West Bengal and the company, and to show comparison with the preceding year certain adjustments have been made to the 1950 figures.

Walsall Conduits, Ltd.—At an extraordinary general meeting resolutions were passed increasing the capital of the company to £500,000 by the creation of 750,000 additional ordinary shares of 4s each, paying up in full at par 250,000 ordinary shares of 4s each to be issued in the proportion of one new ordinary share for every three held, and amending the articles of association. The chairman said that while he could not commit the board regarding the total dividends to be paid for the current year, the directors intend to maintain the interim dividend of 20 per cent on the ordinary capital as increased, paying it at approximately the usual time.

Electrical Switchgear & Associated Manufacturers, Ltd. (a subsidiary of Metal Industries, Ltd.).—At 31st March the group current assets amounted to £980,015 (£757,939) and liabilities to £304,664 (£286,586). The report states that the amount on loan from Metal Industries, Ltd., to Brookhirst Switchgear, Ltd., was substantially increased during the year and on 31st March amounted to £376,000. In addition the subsidiary company had on loan from the company £136,000.

The Lightfoot Refrigeration Co., Ltd., reports a consolidated trading profit of £56,154 (£87,501 in 1950). After providing £25,242 (£22,234) for depreciation and £18,602 (£36,666) for taxation the net profit was £12,310 (£28,601). No contribution is made to general reserve (£10,000 in 1950) and the final dividend is reduced from 5 to 3 per cent, making 6 per cent (8 per cent) for the year. A sum of £46,649 (£45,972) is carried forward.

The Electric & General Investment Co., Ltd., reports that at 31st May current assets amounted to £264,661 (£250,037), while current liabilities totalled £11,350 (£47,818). As from 1st June, 1952, the company is to be assessed for tax as an investment trust but this will have no effect on the investment policy of the company.

The Nigerian Electricity Supply Corporation, Ltd., reports that at 29th February current assets totalled £319,408 (£228,981) and liabilities £37,738 (£38,559). The balance carried forward was £25,523 (£25,632).

Gabriel, Wade & English, Ltd., report that the group profits for the year ended 31st May, before taxation, amounted to £421,512, an increase of £112,709 over the previous year. A dividend of 10 per cent, with a bonus of 5 per cent, is again to be paid and £155,938 (£144,102) is carried forward.

Falk, Stadelmann & Co., Ltd., are to maintain their interim dividend at 10 per cent.

Liquidations

Electrical Services (Cowley), Ltd.—Meetings of members and creditors on 8th September at 126, Colmore Row, Birmingham, 3, for the purpose of receiving an account of the winding-up by the liquidator, Mr. R. F. Bendall.

Little Atom Electrical Products, Ltd., electrical component manufacturers, 6, Market Street, Hay, Breconshire.—Liquidator, Mr. J. M. Clarke, Inveresk House, 346, Strand, London, W.C.2, released 14th July, 1952.

R.E.S., Ltd., manufacturers of electrical appliances, 193, Mare Street, London, E.8.—Liquidator, Mr. J. M. Clarke, Inveresk House, 346, Strand, London, W.C.2, released 14th July, 1952.

P. A. Robinson (Electrical) Co., Ltd.—Particulars of claims by 8th September to the liquidator, Mr. R. A. Rodgers, 25, Bedford Row, London, W.C.1.

Bankruptcies

K. J. Ward, lately residing and carrying on business at "Howard," Trusthorpe Road, Sutton-on-Sea, Lincs, as an electrical contractor.—First meeting held 13th August at 3, Central Buildings, Matthew Parker Street, Westminster, S.W.1. Public examination, 22nd October, at the Court House, St. Leonard's Road, Windsor, Berks.

L. J. Anthony, carrying on business in co-partnership with another at 6, Dolphin Lane, Boston, Lincs, under the style of Dolphin Electric Co., electrical, radio and television engineer. — First meeting 19th August at the County Court offices, 87, West Street, Boston. Public examination 30th October at the Municipal Buildings, Boston.

S. F. Bent, 16, Chatsworth Road, Droylsden, Lancs, electrician, formerly carrying on business as "S. F. Bent & Sons," electrical contractors, at 362, Ashton New Road, Bradford, Manchester.—First and final dividend of 2s 9d in the £, payable on and after 15th August at 20, Byrom Street, Manchester, 3.

R. S. Lees, lately carrying on business at 21, Gledhow Park Road, Leeds, under the style of R. S. Lees & Co., as an electrical factor.—Supplemental dividend of 2⅛d in the £, payable on and after 22nd August at the Official Receiver's office, 29, East Parade, Leeds, 1.

STOCKS and SHARES

THE month of August is not commonly regarded as one in which activity can be expected in Stock Exchange markets, but the last fortnight has certainly produced a somewhat larger share of business and of animation than usual. Prices continue firm, with gilt-edged stocks leading a fairly general advance in markets round the House, other than those concerned mainly with base metals, where the fall in raw material prices has been reflected to some extent in the prices of the shares in companies chiefly concerned. Amongst industrials, it will be noticed that General Electric, 84s 6d, and Electric Construction, 47s 6d, have gained 5s and 4s respectively during the past fortnight, while Lancashire Dynamo, 43s 9d, are 5s 3d to the good. Numerous rises ranging from 6d to 2s 6d are shown in the lists of prices overleaf. Fear of a possible rise in the bank rate has disappeared for the time being.

Dividends and Earnings

With practically all the company accounts for 1951 now published, the following table is given to compare the year's distributable profits (expressed as a percentage on ordinary capital) with those of the year before:—

Company	Earned % 1950	Earned % 1951	Paid %
A.E.I.	100·3	112·2	20
Auto. Tel.	95·1	95·5	15
British Aluminium	29·6	39·8	12
B.I.C.C.	39·2	50·9	9
Babcock & Wilcox	55·3	99·1	18
Chloride El.	72·4	91·2	15
Electric Construction	61·8	53·6	15
English Electric	45·3	56·8	15
Ericssons	124·4	84·8 (*a*)	21·2 t.f.
Henley's	63·0	64·6	20
Laurence, Scott	48·1	72·1	15
Mather & P.	53·5	57·8	12½
C. A. Parsons	215·0	167·4 (*a*)	10
Revrolle	135·7	82·7 (*a*)	10
Switchgear & C.	30·1	43·5	22½
Tel. Condenser	165·6	180 (*a*)	20
Tel. Constr.	26·5	32·4	10
Vickers	10·8	37·0	12½
Allen West	49·8	58·0	15
Westinghouse	29·9	49·2	14

(*a*) On capital increased by share bonuses.

Conservative Dividend Policies

Two main conclusions to be drawn from the above table are, first, that a majority of the companies increased during the year the surplus available for dividends and reserves; and, secondly, that the dividend distribution policies followed strictly conservative lines. In practically all the above cases, the dividend rate is covered more than three times by the available earnings. In considering the earnings figures, further credit should be given for the increasing tendency to strike profits after depreciation provisions much above the inadequate basis permitted for income tax purposes.

Decisions to Come

Concerning bonus issues and the implications which they may have for dividend rates, a decision of special interest due within a few months is that of Tube Investments, whose financial year ended last month. Having paid a total of 25 per cent last year, this company has since distributed a 100 per cent capital bonus, and increased the interim dividend on the old shares (the new issue not participating on that occasion) from 12½ to 13½ per cent. Other companies which have made, or are proposing, free share distributions since the last dividend payments include Scottish Cables (a bonus of 100 per cent), W. T. Henley's (also 100 per cent), Metal Industries (25 per cent), Telegraph Construction (one-for-three), Dubilier Condenser (40 per cent), Ward & Goldstone (one-for-three) and Telegraph Condenser (25 per cent), the last two being sequels to similar distributions recently made.

Old Issues and New

The new issue by Oldham & Son had the effect of strengthening the price to 5s, a rise of 9d since a fortnight ago. The immediate effect of any announcement of a new issue is to bring down the price of the old shares, but as soon as the new are allotted and shareholders have received their letters, the general form nowadays is for the price to recover. In some cases, it has done so substantially. The recent new shares issued by British Insulated Callender's, Henley's, and Telegraph Construction are now on all fours with the older issues, and stand at the same prices as the latter. Siemens new, 32s 6d, are also the same price as their seniors.

Stock on Offer

Among the securities which have lately been available in reasonably large numbers are the 5s ordinary shares of Venner at 7s, at which the yield on the last dividend is 10¾ per cent; of Allen West at 10s 6d, yielding 7·1 per cent; and of Switchgear & Cowans at 14s, to yield 8 per cent. The last-named return is shown also by Watford Electric 2s shares at 6s 3d. Pye 5s deferred and Sangamo Weston 10s ordinary are offered respectively at 16s and 22s 3d, both paying £5 12s 6d per cent on the money. Hoover 5s shares can be bought at 23s 3d to return 7½ per cent, and the same company's 5½ per cent preference shares, at 21s 4½d, yield 5·1 per cent.

Electrical Investments

Past Fortnight's Price Changes

Company	Dividend Previous	Dividend Last	Middle Price 11th Aug. 1952	Fortnight's Rise or Fall	Est. Yield £	Est. Yield s	Est. Yield d
Gilt-edged and Overseas Stocks							
Brit. Elec. 1968/73	3	3	83	+1	3	12	3
Brit. Elec. 1974/77	3	3	81½	+1½	3	13	7
Brit. Elec. 1976/79	3½	3½	87½	+1½	4	0	0
Brit. Elec. 1974/79	—	4½	99	—	4	5	10
Calcutta Elec. ..	6†	6†	20/6	—	5	17	1†
East African Power	7	7	25/6	+6d	5	9	10
Nigerian Elec. ..	10	10	21/3	—	9	8	2
Palestine Elec. "A"	5†	5†	13/6	—	7	8	2†
Perak Hydro-Elec.	Nil	Nil	12/6	+6d	Nil		
Equipment and Manufacturing							
Aberdare Cables (5/-)	20	20	13/9	+2/9	7	5	6
Aerialite (1/-) ..	83½	88½	7/6	+3d	11	14	6
Aron Elec. Ord. ..	15	15	33/9	—	8	17	9
Assoc. Elec. Ord...	20	20	69/6	—	5	15	2
Automatic Tel. & El.	15	15	57/6	+⅛	5	4	2
Babcock & Wilcox	18	18	63/9	—	5	12	10
Baldwin, H. J. (2/-)	25	25	4/9	—	10	10	6
Bakelite (10/-) ..	—	—	17/-	—		—	
British Aluminium	10	12	41/6	+9d	5	15	9
B.I. Callender's ..	7½	9	30/3	—	5	19	0
British Thermostat (5/-)	30	30	24/6	—	6	2	5
British Vac. Cleaner (5/-)	25	25	13/-	+6d	9	12	4
Brook Motors (10/-)	20	20	28/9	—	6	19	2
Brush Ord. (5/-) ..	10	10	5/6	+6d	9	1	10
A. F. Bulgin (1/-)..	27½	30	2/6	—	12	0	0
Burco (5/-) ..	42½	38½	19/6	+9d	9	18	6
Chloride El. Storage	15	15	56/3	—	5	6	8
Cole, E. K. (5/-) ..	25	25*	15/6	+6d	8	1	4
Cossor, A. C. (5/-)	Nil	Nil	11/-	—	Nil		
Crabtree (10/-) ..	17½	17½	32/6	+1/6	5	7	8
Crompton Parkinson Ord. (5/-) ..	11½	11½	8/6	—	6	12	3
De La Rue (5/-) ..	50	35*	12/-	+2/-	10	8	4
Decca (1/-) ..	112½	112½	15/9	+3d	7	2	9
Dewhurst (2/-) ..	35	22½*	4/3	—	—		
Dictograph Tel. (2/-)	20	20	4/6	—	8	17	9
E.M.I. (10/-) ..	8	12	14/9	+1/-	8	2	2
Electrical Components (5/-) ..	20	20	10/-	—	10	0	0
Elec. Construction	15	15	47/6	+1/-	6	5	3
Enfield Cable Ord.	7½	7½	21/-	—	7	2	10
English Electric ..	15	15	55/-	+1/6	5	9	1
Ericsson Tel. (5/-)	22†	22*†	36/3	+9d	3	0	6†
Ever Ready (5/-)..	35	35	24/6	+1/6	7	3	0
Falk Stadelmann	15	15	35/9	—	8	7	10
G.E.C. Ord. ..	17½	22½	84/6	+5/-	5	6	6
General Cables (5/-)	30	30	12/6	—	12	0	0
Greenwood & Batley	15	15	7/-	−⅛	8	2	2
Hackbridge Cable (5/-)	20	20	10/9	+6d	9	6	0
Hackbridge Hewittic (5/-)	18	20	15/-	—	6	13	4
Hall Tel. Acc. (10/-)	10	10	10/-	—	10	0	0
Heatrae (2/-) ..	12½	12½	4/-	—	6	5	0
Henleys (5/-) ..	20	20	17/-	+1/-	5	17	8
Holophane (5/-) ..	15	15	10/-	—		—	
Hoover (5/-) ..	37½	35*	23/3	—	7	10	6
Equipment and Manufacturing (continued)							
Intl. Combustion (5/-)	20	25	22/9	+⅛	5	10	0
Johnson & Phillips	15	15	50/-	+6d	6	0	0
Lancashire Dynamo	22½	12½*	42/9	+5/3	5	14	2
Laurence, Scott (5/-)	12½	15	11/9	—	6	7	8
London Elec. Wire	10	12½	46/3	+⅛	5	8	3
J. Lucas	17½	7½*	32/6	+⅛	4	12	4
Marryat & S. (2/-)	22½	22½	5/-	—	9	0	0
Mather & Platt ..	12½	12½	42/6	+⅛	5	17	3
Metal Industries..	10	15	37/9	xb—		—	
Mid. Elec. Mfg. ..	15	15	55/-	—	5	9	0
Murex	12½	15	53/3	xd—	5	12	9
Newman Ind. (2/-)	6	10	2/6	—	8	0	0
Oldham & Son (1/-)	30	35	5/-	+9d	7	0	0
Parnall (Yate) (5/-)	6	6	3/3	+3d	10	0	0
Parsons, C. A. ..	15	10*	47/6	—	4	4	3
Plessey (5/-) ..	20	22½	17/6	+6d	6	8	7
Pye Deferred (5/-)	35	18*	15/6	−6d	5	16	2
Revo (10/-) ..	27½	27½	38/3	+2/-	6	13	9
Reyrolle	15	10*	44/6	+2/-	4	10	3
Scot. Cable (4/-) ..	30	32	20/9	—	6	3	6
Siemens Ord. ..	10	10	32/6	+1/6	6	3	0
Strand Elec. (5/-)..	17½	17½	8/9	+6d	10	0	0
Sturtevant (5/-) ..	16½†	17½*†	22/-	+9d		—	
Switchgear & Cowans (5/-)	22½	22½	13/9	—	8	3	8
Taylor T. (5/-) ..	20	20	20/-	—	5	0	0
T.C.C. (10/-) ..	20	20*	36/3	—		—	
T.C. & M. ..	10	10	24/-	—		—	
Telephone Mfg. (5/-)	10	10	7/9	—	6	9	0
Thorn Elec. (5/-) ..	20	10*	8/6	—	5	17	8
Tube Investments	25	25	54/-	+⅝		—	
Vactric (5/-) ..	Nil	Nil	4/6	—	Nil		
Veritys (5/-) ..	Nil	7½	4/3	—	8	16	6
Walsall Conduits (4/-)	70	70	45/-xb	—		—	
Ward & Goldstone (5/-)	44	45*	29/-xr	—		—	
Watford (2/-) ..	25	25	6/-	—	8	6	8
Westinghouse Brake	14	14	16/6	+1/6	6	1	0
West, Allen (5/-) ..	12½	15	10/3	−6d	7	8	6
Trusts, Transport and Communications							
Anglo-Am. Tel.: A Ord.	—	4½	77½	—	5	16	2
Ord.	—	56⅔	50	—	5	12	6
Anglo-Portuguese	8	8	20/6	—	7	16	2
Brit. Elec. Traction Def. Ord. ..	22½	25	405	+5	6	3	6
Cable & Wireless: Ord.	6	8	111½	—	7	3	6
4% Loan ..	4	4	96	—	4	3	4
Calcutta Trams ..	6†	6†	23/6	—	5	3	2†
Cape Elec. Trams	4	5	12/6	—	8	0	0
Marconi Marine ..	7½	10	28/-	—	7	3	10
Oriental Tel. Ord.	16	16	55/-	—		—	
Telephone Props.	8	8	28/9	+⅛	5	11	4
Tele. Rentals (5/-)	10	10	8/-	+3d	6	3	0

* After capital bonus.
† Dividends are paid free of Income Tax.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 24th September from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1944

18734. Smith, F. E., Newnam, R. A., and Lucas, H. D.—Automatic electric switching device. 24th October, 1945. (679710.)

1948

5998. Director of the Office of Technical Services, Department of Commerce.—Capacitors and methods and apparatus for making the same. 27th February, 1948. (679816.)

6150. Brush Development Co.—Magnetic recording and reproducing systems. 27th February, 1948. (679817.)

19029. Metropolitan-Vickers Electrical Co., Ltd., and Knowles, A. J.—Apparatus for making blood counts. 8th July, 1949. (679711.)

1949

7485. Verel, B. P.—Speed governors for electric motors. 18th March, 1949. (679915.)

11014. Battelle Memorial Institute.—Method and material for making powder images electrically. 26th April, 1949. (679715.)

11154. Ruston & Hornsby, Ltd., and Feilden, G. B. R.—Gas turbines. 27th April, 1950. (679916.)

12473. Metropolitan-Vickers Electrical Co., Ltd.—Control of tap changers for electric transformers. 30th March, 1950. (679918.)

13069. Electric & Musical Industries, Ltd.—Cathode-ray tube apparatus. 17th May, 1950. Addition to 677983. (679719.)

13520. Standard Telephones & Cables, Ltd.—Electrical power supply equipment. 12th May, 1950. (Cognate application 15967, 15th June, 1949.) (679831.)

15299. Decca Record Co., Ltd.—Cathode-ray tube scanning circuits. 8th June, 1950. (679722.) 15319. Sine-cosine voltage generators. 26th July, 1950. (679723.)

16385. Mouchel & Partners, Ltd., L. G.—Water cooling towers. 2nd June, 1950. (679627.)

16701. Sargrove Electronics, Ltd., and Sargrove, J. A.—Counting or batching devices. 22nd September, 1950. (679959.)

17204. Western Electric Co., Inc.—Cathode-ray tubes. 29th June, 1949. (679725.)

17734. Trup & Co., Ltd., S., and Sieff, R.—Electric signs. 16th June, 1950. (679838.)

18609. General Electric Co., Ltd., and Bryer, R. F.—Timing devices. 13th July, 1950. (679963.)

18783. Electric & Musical Industries, Ltd.—Magnetic sound recording or reproducing media and magnetic sound recording or reproducing apparatus for use therewith. 17th July, 1950. (679962.)

18987. British Thomson-Houston Co., Ltd., and Sims, W. J.—Lidless kettles for boiling water and like liquids. 13th June, 1950. (679728.)

19944. English Electric Co., Ltd.—Water boilers. 31st July, 1950. (679921.)

20819. Benjamin Electric, Ltd., and Smith, A. G.—Lighting fittings. 3rd August, 1950. (679922.)

20900. Turnock, Ltd., G.—Adaptors for electric lamp-holders. 13th November, 1950. (679840.)

21490. Western Electric Co., Inc.—Electron beam coding tubes and signal encoding systems using such coding tubes. 23rd September, 1949. (679730.)

25729. Hunt (Capacitors), Ltd., A. H.—Manufacture of wound capacitors from metallized dielectric. 20th September, 1950. Addition to 563080. (679732.)

25835. Communications Patents, Ltd.—Dielectric heating apparatus. 8th January, 1951. (679644.)

26117. Metropolitan-Vickers Electrical Co., Ltd.—Couplings for shafts and the like. 9th October, 1950. (679968.)

27026. Electric & Musical Industries, Ltd.—Target structures such as are utilized in television pick-up tubes. 5th October, 1950. (679846.)

27069. Philips Electrical, Ltd.—Optical-projection apparatus incorporating a cathode-ray tube. 21st October, 1949. (679847.)

27514. Enfield Cables, Ltd., Klein, N., and Sutton, C. T. W.—Detection and location of leaks in gas-filled cables and pipe-lines. 26th October, 1950. (679928.)

27934. Elliott, S. R.—Electric heat accumulating stoves and the like. 7th December, 1950. (679971.)

28362. N.G.N. Electrical, Ltd.—Electric lampholders. 6th November, 1950. (679849.)

30007. Huebner, W. C.—Method and apparatus for the reproduction of an image or coating by precipitation of material in an electrostatic field. 23rd November, 1949. Convention date not granted. (679974.)

30447. Autophone, Ltd., and Sauter, J. B.—Electric telephone keys. 27th November, 1950. (679975.)

30599. General Electric Co., Ltd., and Friedlander, E. S.—Electric inverting systems. 29th November, 1950. (679653.)

30627. Walter Instruments, Ltd., Armstrong, C. J., and Noad, J. E. G.—Electrical relays. 29th November, 1950. (679856.)

30706. C.A.V., Ltd.—Means for operating a gas-discharge lamp from a low-voltage direct-current source. 22nd November, 1950. Addition to 667764. (679857.)

31893. Chessin, M., and Munschak, U. Z.—Electric smoothing irons. 12th December, 1949. (679657.)

32090. Contactum, Ltd., and Bollinghaus, W.—Electric plug and socket connectors. 14th December, 1950. (679976.)

32718. Western Electric Co., Inc.—Signal transmission systems using pulse code modulation. 21st December, 1949. (679737.)

32846. Wartsila-yhtyma o/y Wartsilakoncernen Aktiebolag.—Electric wiring junction boxes. 22nd December, 1949. (679978.)

32995. Standard Telephones & Cables, Ltd.—Manufacture of electric cables. 22nd December, 1950. (679934.)

1950

566. Rolls-Royce, Ltd.—Resistance welding apparatus. 18th December, 1950. (679739.)

836. Sciaky, D.—Single-phase electric converting system. 12th January, 1950. (679979.)

987. National Research Development Corporation.—Electronic pulse output circuits for thermionic valves. 5th January, 1951. (679862.)

1157. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 9th January, 1951. (679660.)

1556. Imperial Chemical Industries, Ltd.—Insulated electrical conductors. 19th January, 1951. (679935.)

1621/2. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for making blood counts. 27th December, 1950. (679740/1.)

2482/3. Babcock & Wilcox, Ltd.—Tubulous vapour generators. 31st January, 1950. (679866/7.)

5598. British Thomson-Houston Co., Ltd., and Morrison, S. J.—Self-centring chucks for glass-working machines. 1st January, 1951. (679668.)

5937. Horstman, Ltd.—Electric switches suitable for use in hand-operated portable electrical apparatus. 6th June, 1951. (679874.)

6139. Siemens & Halske Akt.-Ges.—Arrangement for telephone subscribers' sets. 10th March, 1950. (679875.)

6235. Philips Electrical Industries, Ltd.—Circuits for automatic frequency control. 13th March, 1950. (679767.)

6280. British Electrical & Allied Industries Research Association.—Electromagnetic recording apparatus. 13th March, 1951. (679938.)

6391. British Thomson-Houston Co., Ltd.—Phase-shifting networks. 14th March, 1950. (679672.)

6509. British Thomson-Houston Co., Ltd.—Lighting generators for motor-cycles. 11th January, 1951. Addition to 621061. (679750.)

7748. Radio Corporation of America.—Semi-conductor devices. 28th March, 1950. (679674.)

7893. British Thomson-Houston Co., Ltd., and Beeson, E. J. G.—Electric discharge lamps. 20th March, 1951. (679755.)

8954. Automatic Telephone & Electric Co., Ltd.—Thermionic amplifiers. 30th March, 1951. (679679.)

9243. General Electric Co., Ltd., and Thompson, G. T.—Alternating current bridges. 11th July, 1951. (679680.)

10933. British Thomson-Houston Co., Ltd.—Rotary snap-action switches. 3rd May, 1950. (679682.)

11019. Evans, D. J.—Electrolytic sterilizing apparatus. 4th May, 1951. Addition to 638694. (679879.)

11179. Zenith Radio Corporation.—Electronic signal translating devices. 5th May, 1950. (679769.)

11838. Chase Electric Co., Ltd.—Appliance for reversing tubes of flexible material. 8th May, 1951. (679943.)

13462. Thurston, A. P. (Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, & Cirey).—Apparatus for the regulation of electrical voltages. 30th May, 1950. (679689.)

14656. Standard Telephones & Cables, Ltd.—Circuits for cathode-ray oscilloscopes. 11th June, 1951. (679768.)

15099. General Electric Co., Ltd., and Bryer, R. F.—Apparatus for use in serial radiography. 31st May, 1951. (679950.)

15389. Igranic Electric Co., Ltd.—Lifting magnets. 20th June, 1950. (679769.)

15486. Standard Telephones & Cables, Ltd.—Radio direction finding equipment. 21st June, 1950. (679692.)

16610. Babcock & Wilcox, Ltd.—Tubulous vapour generating and superheating units. 4th July, 1950. (679695.)

17569. General Electric Co., Ltd., and Simpson, A. I. F.—Crystal filter circuits. 6th June, 1951. (679888).

17842. Metropolitan-Vickers Electrical Co., Ltd., and Knowles, A. J.—Apparatus for making blood counts. 8th July, 1949. Divided out of 679711. (679774.)

20126. Igranic Electric Co., Ltd.—Electrical contact devices particularly for electric switches. 14th August, 1950. (679998.)

20437. Westinghouse Electric International Co.—Multi-car elevator systems. 17th August, 1950. (679999.)

20500. Standard Telephones & Cables, Ltd.—Airport wind indicating and warning system. 18th August, 1950. (679779.)

23974. Brooke, W., and Baldwin, H. T.—Earth leakage protection for single-phase a.c. circuits. 30th September, 1950. (679789.)

24158. MacDermid, P.—Control apparatus for slip-ring induction motors. 3rd October, 1950. Addition to 672773. (679703.)

24364/5. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for counting the number of particles present in a liquid medium. 5th October, 1950. Divided out of 679711. (679791/2.)

25619. British Thomson-Houston Co., Ltd.—Manufacture of sealed evacuated envelopes. 20th October, 1950. (679795.)

27188. Taylor, R. D.—Rotary switch with floating contact arm. 7th November, 1950. (679799.)

27810. Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz.—Recording electro-magnetic oscillograph. 14th November, 1950. (679801.)

30343. British Thomson-Houston Co., Ltd.—Electric valve excitation circuits. 12th December, 1950. (679902.)

1951

707. Standard Telephones & Cables, Ltd.—Keyed frequency modulation carrier wave communication systems. 10th January, 1951. (679901.)

1491. Standard Telephones & Cables, Ltd.—Electromagnetic waveguides. 19th January, 1951. (679902.)

3196. Standard Telephones & Cables, Ltd.—Multi-channel microwave transmission system. 9th February, 1951. (679903.)

5930. Porsche Konstruktionen Ges.—Ventilation of the electric motors of electrically-driven road vehicles. 12th March, 1951. (679904.)

12296. Director of the Office of Technical Services, Department of Commerce.—Method of manufacturing a roll type capacitor and the resulting product. 27th February, 1948. Divided out of 679816. (679907.)

TRADE MARKS

RECENT applications for the registration of trade marks include the following, objections against which may be entered up to the dates stated :—

30th August

CRUSTEX. No. 703,741. Class 9. Electrical apparatus for the prevention and removal of incrustations and scale in liquid containers by the action of supersonic vibrations.—H. R. Hilfiker & Co., Zurich. Address for service: c/o G. F. Redfern & Co., Dominion Street, London, E.C.2.

KARMA. No. 707,583. Class 9. Electrical resistance wire made of nickel-chromium alloy.—Driver-Harris Co., New Jersey, U.S.A. Address for service: c/o Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, London, W.C.2.

SINCOMAT. No. 707,978. Class 9. Magnets.—Murex, Ltd., Ferry Lane, Rainham, Essex.

6th September

DYNEX. No. 706,448. Class 7. Electric welding machines and electric generators, and electric generators in combination with an engine or a motor, all for use with electric welding machines. No. 706,420. Class 9. Electric arc welding apparatus (not machines).—Macfarlane Engineering Co., Ltd., 49, Netherlee Road, Cathcart, Glasgow, S.4.

SERVISEAL. No. 708,123. Class 7. Compressors and electric motors for use with refrigerators. No. 708,124. Class 11. Condensing units for refrigerators.—Marco Refrigerators, Ltd., Manor Works, Rowan Road, Streatham Vale, London, S.W.16.

TELEFLEX. No. 690,483. Class 9. Parts of apparatus and instruments included in Class 9 adapted for operation by cable-actuated remote control mechanisms; electrically operated window and door opening and closing devices; wireless aerials and masts; and indicators, mechanical and electrical advertisement signs, and speed governors, all being goods incorporating flexible metal cables for transmitting movement and included in Class 9.—Teleflex Products, Ltd., 9, Cavendish Square, London, W.1.

ULTRASONEL. No. 703,464. Class 9. Apparatus employing supersonic pressure waves and being for industrial use in the testing of materials.—Ateliers de Constructions Electriques de Charleroi, Brussels. Address for service: c/o Feeny & Feeny, 2a, Charlwood Place, Westminster.

LOFROD. No. 706,791. Class 9. Radio and television aerials.—Belling & Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex.

LAMCOR. No. 707,536. Class 9. Parts included in Class 9 of electrical instruments made of laminations of common metal.—Linton & Hirst, Ltd., Lam Works, Palmerston Road, Wealdstone, Middlesex.

SUPERSTAT. No. B701,727. Class 11. Electrically operated installations for softening and purifying liquids.—Superstat, Ltd., 22, Hans Road, Brompton Road, London, S.W.3.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—BRISBANE.—8th October. State Electricity Commission of Queensland. Insulators and accessories. (C.R.E. 26870/52. Ten/4456.)* 12th November. Substation batteries and charging equipment. (C.R.E. 26869/52. Ten/4439.)*

SYDNEY.—4th September. County Council. Percentage differential protective relays. (C.R.E. 26733/52. Ten/4435.)*

Belfast. — 12th September. Electricity Department. Mobile pole moving equipment. (See this issue.)

Belgium.—BRUSSELS.—20th August. Belgian State Railways. Equipment for radio control of locomotives. (C.R.E. 26241/52. Ten/4459.)* 20th August. Belgian Telephone and Telegraph Administration. Equipment and accessories for telephone installations. (C.R.E. 26609/52. Ten/4460.)*

Cleethorpes.—3rd September. Corporation. Electrical installations in 98 dwellings. (See this issue.)

Cockermouth. — 3rd September. U.D.C. Street lighting. (See this issue.)

Dearne.—30th August. U.D.C. Street lighting equipment. (See this issue.)

Haverfordwest.—22nd September. Town Council. Electrical installations in 143 houses. Deposit £2. Borough engineer, Victoria Place.

New Zealand.—AUCKLAND.—1st September. Auckland Electric Power Board. Six 750 kVA 3-phase transformers. (C.R.E. 26746/52. Ten/4430.)*

WELLINGTON.—18th September. Post and Telegraph Department. Power cables and fittings. (C.R.E. 26738/52. Ten/4455.)*

North of Scotland.—29th August. Hydro-Electric Board. Cables. (See this issue.)

South Africa. — JOHANNESBURG. — 3rd September. South African Railways Stores Department. Yard lighting lantern fittings. (C.R.E. 27401/52. Ten/4452.)* Radio equipment for Buffalo Harbour Signal Station. (C.R.E. 27480/52. Ten/4451.)*

Uganda.—Electricity Board. 30 MVA. 132/33 kV transformers. (See this issue.)

Uruguay. — MONTEVIDEO. — 10th November. Direccion General de Communicaciones (Servicio de Transmissions). Supply of 20,000 porcelain petticoat insulators. (C.R.E. 27159/52. Ten/4449.)*

ORDERS PLACED

Grimsby. — Corporation. Recommended. Installation of vehicle-actuated traffic lights at Hainton Avenue-Pasture Street (£865) and Dudley Street, Bargate-Deansgate (£1,138).—Automatic Telephone & Electric Co., Ltd.

Accepted. Electrical installations in 182 houses, Little Coates Estate (£5,874); and 43 houses, Carr Lane Estate (£1,395).—Hobson & Scott, Ltd.

Manchester.—Corporation Housing Committee. Accepted. Electrical installations in 212 houses and 12 aged persons' dwellings at Charlestown.—S. B. Wainwright & Co.

Northumberland.—Education Committee. Accepted. Electrical installation, Backworth County Primary School and the teachers' and caretaker's houses (£341). Mood & Sons. Electrical work, Blyth South Farm County Mixed School (£110).—B. French, Ltd.

South Shields.—Town Council. Accepted. Electrical installation in connection with the conversion of premises in Victoria Road, as a building department for the Technical College (£625), and re-wiring of Stanhope Road County Junior Mixed School (£1,407).—C. Ramsay & Son. Re-wiring of Gilbert Street County Infants' School (£708).—Bonham Electrical Co., Ltd.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Abingdon.—Houses (260), Sutton Courtney; surveyor, Rural Council Offices, Bath Street.

Altrincham.—Houses (57), Golf Course estate, Lorraine Road; Sparke & Stephens, Ltd., 105, Wood Lane, Timperley.

Amersham.—Fire station, Woodside Road, for Bucks C.C.; Rust & Ratcliffe, builders, Higham Road, Chesham.

Basingstoke.—Factory extension for Kelvin & Hughes, Ltd., By-Pass Road; Mussellwhite & Son, Ltd., builders, Eastrop Works.

Berkeley.—Ambulance station for Gloucester C.C.; county architect.

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Horse Guards Avenue, Whitehall, S.W.1 (Trafalgar 8855).

Birmingham.—Modern mixed school, Moseley (£164,199); W. J. Whittall & Son, builders. Junior school, Shard End (£59,282); J. Dallow & Sons, Ltd., builders.

Brighton. — Factory premises, Moulsecomb Way; R. J. Adcock & Co., Ltd., Islip Street, N.W.5 and New Welbeck, Ltd., 94, New Bedford Road, Luton.

Bristol.—Office block at Brislington; Stone & Co., Ltd., builders, Redland Road.

Cardiff.—Factory, Newport Road; South Wales Precision Tool Co., Ltd., 121, Caerleon Road, Newport, Mon.

Coalville.—Houses (80), Greenhill Road site (£109,560); Council's architect and surveyor.

Coventry.—Dwellings (261), Bell Green; city architect.

Croydon.—Reconstruction and extension of factory premises; Powers-Samas Accounting Machines, Ltd., Aurelia Road.

Douglas (Isle of Man).—Children's wing and operating theatre unit, Westmorland Road; E. C. Kneale, secretary, Noble's (I.O.M.) Hospital, Douglas, I.O.M.

Dover.—Five shops and flats, Market Square; Legal & General Assurance Society, Ltd., 188, Fleet Street, E.C.4.

Houses (42), Buckland estate; borough engineer.

Durham.—Children's homes at Houghton, Tow Law, Bowburn and Peterlee, and residential nurseries at Penshaw, Hartburn Lodge and Stockton; county architect, Court Lane, Durham.

East Kilbride.—Bacon curing factory, Calderwood Glen; J. W. Galloway, Ltd., 11, Cleland Street, Glasgow, C.5.

Eccles.—Church hall at Chadwick Road for Presbyterian Church; T. Reive, architect, 7, Parsonage Road, Heaton Moor, Stockport.

Gosport.—Flats (76), Camp Road site; Hawkins Bros., Ltd., builders, Westfield Road, Gosport.

Helmsdale (Sutherland). — School for Sutherland C.C.; county architect, Dornoch.

Hemel Hempstead.—Houses (190), Apsley-Bennetts End; Architect's Dept., Development Corpn., Westbrook Hay.

Hounslow.—Church, Bridge Road and Worton Road; Wm. Lacey (Hounslow), Ltd., builders, Hospital Bridge Road.

Hull.—Showrooms and offices, King Edward Street; Ravenseft Properties, Ltd., 16, Charles Street, W.1.

Flats (66), Vauxhall Grove; city architect.

Hyde.—Shops at Harbour Farm estate; H. T. Barnes & Sons, Ltd., 23, Richmond Road, Altrincham.

Ilford.—Houses (96), shops and maisonnettes, Barkingside, in three contracts; borough surveyor, Town Hall.

Kendal.—Houses (36), at Hall Garth Estate; borough surveyor, Town Hall.

Lanarkshire.—Buildings for Lanarkshire Fire Brigade at Bothwell Road, Hamilton; L. W. Hutson, 119, Cadzow Street, Hamilton. Fire station buildings, Cleghorn Road, Lanark; Gavin Paterson & Son, 9, Cadzow Street, Hamilton.

Lancashire.—Additional classrooms, Newton-le-Willows Grammar School; Building Contractors, Ltd., Statham. Winton Secondary Modern School; Neodox, Ltd., Atlantic Chambers, Brazennose Street, Manchester. Buxton C.E. School; A. M. Tomlinson & Sons, Church Villa, Leyland.

Leek (Staffs).—Houses (30), Brown Edge site, for R.D.C.; Frost & Co. (Builders & Contractors), Ltd., High Lane, Stoke-on-Trent.

London.—KENSINGTON.—Flats (15), Silchester Road and Walmer Mews; John Grey & Partners, architects, 17, Buckingham Street, Strand, W.C.2.

ST. MARYLEBONE.—Flats (34), Abercorn Place site; Clifford E. Culpin, architect, 3, Southampton Place, W.C.1.

Lowestoft.—School for sub-normal children; East Suffolk county architect, E. J. Symcox, county architect, County Hall, Ipswich.

Melksham.—Houses (32), Woodrow Park Estate; U.D.C. surveyor, Town Hall, Melksham, Wilts.

Merthyr Tydfil.—Flats (32) and houses (127), Swansea Road; borough surveyor.

Newhaven.—Houses (88) Northdown Road; Saunders (Contractors), Ltd., London Road, Burgess Hill.

Nottingham.—Schools at Clifton (3), Wollaton (2), Bilborough and Bestwood; R. M. Finch, city architect, Guildhall.

Houses (102), Arnold Road, Bestwood; J. W. Stamp & Co., Ltd., Nuthall Road.

Oswestry.—Dwellings (76) for R.D.C.; S. T. Walker, architect, 83, Suffolk Street, Birmingham.

Plymouth.—Business premises, New George Street (£30,000); Fullers, Ltd., caterers, etc.

Spalding.—Offices and Council Chamber on site near St. Peter's Hall, Priory Road, for R.D.C.; Wm. Saunders & Partners, Newark-on-Trent.

Stanley (Co. Durham).—Chest clinic and outpatients' dept. at Holmside and South Moor Hospital for Newcastle Hospital Board, "Dunira," Osborne Road, Newcastle-on-Tyne; own architects.

Stockton-on-Tees.—Houses (389) for the T.C. Builders: Lane, Fox & Co., Sunderland (198), and Fordy & Son, Stockton (191).

Junior school on the Roseworth estate; borough architect, 28, The Square.

Truro.—Accommodation for nurses at Royal Infirmary (£25,000); architect to South Western Regional Hospital Board, Roxburgh, Clifton Down, Bristol, 8.

Wallingford.—Houses (34); C. R. Lawless, borough surveyor, High Street.

West Hartlepool.—Flats (216) for the T.C. Builders: W. W. Brazell, Ltd. (36); Taylor & Evans (72); and C. M. Yuill, Ltd. (108). All local firms.

Worcestershire. — School at Franche, Kidderminster, and reconstruction (after fire) of laboratory block at Halesowen Grammar School; L. C. Lomas, county architect, 14, Castle Street, Worcester.